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EDITORIAL

PROSPECTS for copper have been the subject of review during the past month by the chairmen of the two mining groups active in Northern Rhodesia. In his statement accompanying the reports and accounts of the Rhodesian Selection Trust group of companies the chairman, Sir Ronald Prain, has " no doubt that taking the longer view the copper industry will continue to expand in line with requirements " and that " as far as consumption is concerned, there is no reason to suppose that it will not continue to be satisfactory." Mr. H. F. Oppenheimer, in his review of the affairs of the Rhokana Corporation, is equally optimistic. He says, " long-term prospects . . . remain encouraging " and " the upward trend in consumption promises to continue."

EARLY in the New Year the British Columbia and Yukon Chamber of Mines will be celebrating its 50th Anniversary. To mark the occasion the Chamber is to hold a " Prospecting and Exploration Conference " in Vancouver on February 16 next. It is anticipated that about 400 delegates will attend, including prospectors, exploration engineers and geologists, business and supply leaders, and members of Government departments. A special feature of the meeting is to be a " Display and Discussion Room " in the conduct of which the B.C. Department of Mines, the Geological Survey of Canada, and the Department of Northern Affairs and National Resources are all co-operating by having staffs on hand to answer questions and give information regarding prospecting and mining.

SPEAKING to local authorities in Kiruna recently Mr. Arne Lundberg, managing director of LKAB, said that present indications were that current output, now running at about 13,000,000 tons annually, would reach 15,000,000 tons by 1965 and 18,000,000 tons by 1968, when the new development at Svappavaara came into full operation. Mr. Lundberg also mentioned the Haukivaara strike just north of the centre of the Kiruna mine. This, he said, had come as a surprise, since the iron ore was hematite containing high percentages of iron and phosphorus. The deposit seemed to be between 200 m. and 300 m. in length and 50 m. wide, but at the moment its depth could not be established. It appears that production at Kiruna is increasing more rapidly than had been expected and it is thought likely that output figures in the next few years will be exceptional.

EARLIER this month Dr. M. G. Fleming, newly-appointed Professor of Mineral Technology at the Royal School of Mines, delivered his inaugural lecture. Speaking in the new Physics Lecture Theatre at Imperial College, Professor Fleming stressed the importance of minerals other than coal and iron in the economy of the United Kingdom, suggesting that awareness of the country's dependence on such minerals had not been sufficiently well brought home either to the " man-in-the-street " or even to those in authority; a live mineral policy was an obvious and urgent need. Minerals unobtainable at home must still come from abroad and whereas in the past the Commonwealth had been able to supply the newly-emerged independent nations would need more than exploration to develop their resources; they would need assistance in the form of financial and technical aid, in the supply of which the new graduates in mineral technology could well play an important part.

DURING the past fortnight the Turkish Government, through its agency the Turkish Coal Enterprises, has been acting as host to a CENTO Coal Symposium. Held in Zonguldak and other mining centres the meeting was attended by representatives of Turkey, Iran, Pakistan, the United Kingdom, and the United States. A number of comprehensive papers and discussions covering the economics of coal production, mining problems, and the geology of coal mining

were presented, while in addition visits were paid to surface and underground mines, coal washeries, power plants, and harbour facilities at Zonguldak and to mines in the vicinity of Eskiseher, including the Seyit Omer lignite strip mine and the Tunçbilek open-pit and underground mines. At Soma, near Izmir, the delegates inspected the Çamlica mine and visited the famous ruins at Bergama. It is thought that the published report of the project will be available for distribution approximately three weeks after the completion of the Symposium.

IN the November issue attention was drawn to a new shaft-sinking record achieved in South Africa. This month still further evidence of the effect of modern drilling and blasting techniques on the speed of underground development is available in the announcement of an exceptional tunnelling feat achieved in a Rand gold mine. On December 6 Western Deep Levels announced a " holing-through " of the return airway of the twin haulages on 66 level between No. 2 shaft and No. 3 shaft. This entailed driving 9,500 ft. between the two shafts and the actual development of 23,000 ft. First begun from No. 3 shaft in May, 1960, when the ventilation shaft had been sunk to a depth of 6,600 ft., high-speed development did not begin until October, 1960. Work began from No. 2 shaft only in June this year, the fastest advance in any one month being achieved in November with a length of 1,510 ft. from No. 2 shaft. Treble shifts each of 8 hours were worked and a multi-blast system adopted. When 69 ft. remained to be driven in the return airway a diamond drill was put through from the east drive to the west drive and showed that the survey had been completely accurate both in elevation and in direction and the drives were " spot on."

LAST month the BP Exploration Company announced that it is expected to produce a total output of more than 100,000 tons of crude oil this year from its oilfields in England, as compared with 85,000 tons in 1960. In these fields, mostly in the East Midlands, the increase in production has been due both to the development of recent discoveries and to an improvement in the output from established fields. A pumping production test is being carried out on the latest discovery well, Glentworth No. 1, near Gainsborough, in Lincolnshire, where oil was found this year at a depth of 3,600 ft. in Coal Measures sandstone. Sites have been located for four wells to test this structure and they are to be drilled shortly. The company states that development drilling is being continued on both the Lincolnshire and Nottinghamshire sides of the River Trent and a total of 20 wells has been completed. Appraisal drilling is also progressing at the South Leverton oilfield, in Nottinghamshire, where 10 wells have now been completed. BP Exploration's main East Midlands producing oilfields are Eakring and Duke's Wood, Kelham Hills, Egmanton, and Bothamsall (all in Nottinghamshire), Plungar (Leicestershire), and Gainsborough and Corringham (Lincolnshire). An extended production test of the well at Kimmeridge, Dorset, is also making a useful contribution to total oil production.

Chemical Engineering Congress

Advance details have been released this month by the Department of Scientific and Industrial Research of a meeting to be held in London next June—the Third Congress of the European Federation of Chemical Engineering—organized by the Institution of Chemical Engineers. Its scope will comprise four symposia, one of which is expected to interest those concerned with metal extraction. The four subjects are: Interaction between fluids and particles, handling of solids, process " optimization," and the physics and chemistry of high pressures.

A summary of each has been prepared which will serve as an introduction. Thus the subject of interaction between fluids and particles has been selected as one in which basic research is required by industry. The title is designed to cover a broad field and a variety of papers has been accepted. Emphasis will be on the underlying scientific principles rather than on the individual operations. On the handling of solids it is suggested that there is a great need to be able to control bulk solids for process purposes and that so far design has been based largely on experience or rule of thumb because of the lack of sound theory applicable

to bulk solids systems. This has arisen in part it is thought because of the number of variables needing definition and leading to very complex mathematical descriptions and in part because of the number of long-established industries handling bulk solids, each with its nucleus of hard-won practical experience. Most of the problems which have arisen have been solved by trial and error. The papers for presentation fall into groups dealing with the study of the controlled flow of bulk solids, the cohesion of solid particles to one another in the formation of agglomerates, continuous weighing, and problems arising in handling.

Regarding process "optimization," or of automation under optimum conditions, this is thought to be a subject of great interest to chemical engineers. It is pointed out that large sums of money are being spent by industry on the development of techniques in this field and that up to the present discussion has been limited. The symposium on the physics and chemistry of high pressures will cover theoretical, experimental, and applied work on high pressures from about 1,000 atmospheres upward. The subjects to be discussed will include changes of phase, the study of rates of chemical reactions, and work on new techniques, equipment, and design. It remains to be seen to what extent this ambitious programme will be of interest to metallurgists and mineral technologists.

Australian Mineral Production

In the Australian Mineral Industry Review for 1960 [1] published in mid-November by the Bureau of Mineral Resources it is disclosed that output for the year attained its highest recorded level, reaching approximately £A236,000,000 as compared with £214,000,000 in 1959 and £217,000,000 in 1956, the previous peak year. In connexion with this report Senator the Hon. W. H. Spooner, Minister for National Development, has pointed out that the published figures do not include the value of uranium oxide produced, but he has indicated that this approximates to £11,000,000 annually.

[1] Canberra: Bureau of Mineral Resources, and London: Australia House. Price 20s.

In the year under review there were notable increases in the production of coal, copper, ilmenite, iron ore, tungsten, and zinc while production of most other minerals also showed an increase over the 1959 level. In the non-ferrous metal field lead had a difficult year in 1960, with mine output at its lowest since 1957, but mine production of zinc was little short of the record 1957 level and metal production established a new record, while copper made notable progress, largely as a result of developments at Mount Isa. Production of copper in 1960 exceeded 100,000 tons for the first time and plant developments should, it is believed, make Australia entirely self-sufficient in the production of refinery shapes. The output of black coal rose by more than 2,000,000 tons, while exports more than doubled. The bulk of increased production and exports was from New South Wales.

To the remarkable discoveries of large reserves of iron ore made in Australia since the Commonwealth Government decided to permit the export of such ore on a controlled and limited basis there have been frequent references in the MAGAZINE and elsewhere in this issue our correspondent in Melbourne refers to a find made as the outcome of recent exploration in the Pilbara district in the north-west of Western Australia. While the Minister for National Development has warned that the real significance of the new discovery must await the results of detailed testing it is thought likely "there are good prospects of the reserves proving to be substantial—perhaps of the order of four or five times the known Australian reserves of 368,000,000 tons." The Minister has stressed that if the early promise of the deposits is fulfilled Australia's iron-ore position could be transformed and the Commonwealth enabled to expand its steel industry and enter into substantial long-term commitments for the development of an export trade. At the same time, he said, the potential benefits to Western Australia would be recognized, since a steel industry in the West would lay the economic foundation for the State's industrial development. The first big step in this direction had already been taken in the recent decision of Broken Hill Proprietary to establish a £44,000,000 steel industry at Kwinana (near Perth)—a decision made possible by the agreement between the Commonwealth and the State to provide a standard-gauge railway from the iron-ore deposits at Koolyanobbing to Kwinana at a cost of £41,000,000.

MONTHLY REVIEW

Introduction.—There is uneasiness over the situation in Congo and the apparent failure of the talks on banning nuclear weapons, as well as uncertainty as to the outcome of Britain's approach to the Common Market. Confidence, in general, is gaining ground and there is a more expectant approach to the New Year, in spite of the general unrest regarding the Government's " pay pause." Lead and zinc prices continue weak, but the Katanga crisis may soon affect the copper market.

South Africa.—The output of the Rand mines for October totalled 1,928,466 oz., making with 40,276 oz. from outside districts a total of 1,968,742 oz. for the month. At the end of the month there were 386,239 natives at work in the gold mines, as compared with 381,659 at the end of September.

The operations of BUFFELSFONTEIN GOLD MINING in the year to June 30 last resulted in a profit of R12,355,817, of which R7,107,906 was appropriated for capital expenditure and R3,850,000 taken for dividends equal to 35 cents a share. In the year 1,781,000 tons of ore was milled for gold and 754,854 oz. of gold recovered, while 752,996 lb. of uranium oxide was also produced. At June 30 last the ore reserves were estimated as 4,922,000 tons averaging 9·74 dwt. in gold and 0·693 lb. of uranium oxide per ton.

At the annual meeting of HARTEBEESTFONTEIN GOLD MINING last month shareholders were informed that it is now anticipated that preparatory work on No. 5 shaft will commence during the latter half of 1964 and full-scale sinking towards the middle of 1965. As sinking of the shaft is expected to take about 12 months, after which three to four months will be required for installation of shaft equipment, No. 5 shaft is likely to be in commission towards the end of 1966.

With the recent dividend notice shareholders of MESSINA (TRANSVAAL) DEVELOPMENT were told that the estimated net profit for the year ended September 30 last is R2,191,800.

The accounts of the ANGLO-TRANSVAAL CONSOLIDATED INVESTMENT COMPANY for the year to June 30 last show a profit of R2,073,232 and a total of R3,038,698 available, of which dividends equal to 60% on the ordinary and A shares require R915,000.

As the result of the agreement reached by SOUTH AFRICAN TORBANITE MINING AND REFINING with the " big five " of the petroleum world—B.P. Southern Africa (Pty.), Caltex (Africa) (Pty.), Shell South Africa (Pty.), Total Oil Products (Pty.), and Vacuum Oil Co. of South Africa (Pty.)—the latter will supply for refining 25,500,000 gal. of crude oil a year, market the refined products, and compensate the former sufficiently to ensure a reasonable profit, equivalent to a net income of 10% on capital invested and employed in its refinery operation. The agreement is to run indefinitely, subject to at least five years notice of termination from both sides. The refining company—SATMAR—is free to engage in other business than that falling under the agreement but use of the refinery for such other business will necessitate the negotiation of a new level of income receivable from the other parties.

ROOIBERG MINERALS DEVELOPMENT has installed a more powerful electric hoist at its Gap Shaft, in which sinking proceeds, to facilitate hoisting from a greater depth. Development on the lode served by this shaft has disclosed another lode, which has yielded encouraging results. In another section of the workings surface drilling has disclosed a new lode with moderately encouraging results. All in all, development and drilling have yielded results quite encouraging for the future.

It is announced that TRANSVAAL NAVIGATION COLLIERIES is installing, and expects to commission in its 1960–61 year, a new " Norwalt " washing plant. This will facilitate increasing the working height and producing more consistent values in the various sales products. Studies are being conducted into modifications to the railway yard and the existing plant to yield additional sized products and provide boom-loading to reduce coal breakage. Certain areas of the company's property, which is in the Bethal district of the South-eastern Transvaal, are under option to an important mining group in respect of gold-bearing reefs.

The directors of PRESIDENT BRAND GOLD MINING recently announced that borehole S.P.10 on the farm Stuirmanspan, situated 10,600 ft. due south of No. 2 shaft, intersected the Basal Reef between 4,807 ft. and 4,810 ft. assaying 7·5 dwt. of gold per ton over 35·6 in. Similar results were obtained in two deflections, core recovery being complete.

It is reported that satisfactory progress is being made on the R14,000,000 smelting and refining plant at Tsumeb, near Kombat, in South-West Africa and it is expected to begin operating some time next year. The plant

will have a copper smelter with a capacity of 30,000 tons to 40,000 tons of blister copper a year and a lead smelter with an 80,000-ton per annum capacity.

Southern Rhodesia.—The accounts of the WANKIE COLLIERY COMPANY for the year ended August 31 last show a profit of £977,373, of which dividends equal to 1s. 3d. a share require £659,726. In the year the company produced 3,418,934 tons of coal, 182,515 tons of coke, and 1,019,661 tons of tar as well as 34,803 tons of bricks and refractories, 1,143 tons of ammonia liquor, and 717 tons of benzole.

Northern Rhodesia.—In his statement accompanying the report and accounts of the RHODESIAN SELECTION TRUST group of companies for the year ended June 30 last the chairman, Sir Ronald L. Prain, says that production from MUFULIRA, ROAN ANTELOPE, and CHIBULUMA during the year was 202,041 long tons, as against 217,057 tons in the previous year. The reduction is, he says, due to a deliberate curtailment of production. Total ore reserves at the group's mines, including those in the undeveloped Baluba and Chambishi properties, are estimated as 432,291,000 tons. The reports for the three operating companies for the three months ended September 30 last show that Mufulira produced 27,139 long tons of copper for an estimated profit of £1,751,000, Roan Antelope 19,709 tons for £935,000 profit, and Chibuluma 3,875 tons for £81,000.

In the year to June 30 last the RHOKANA CORPORATION produced 24,345 long tons of blister copper and 82,536 tons of electrolytic and made a profit of £10,955,993. Fully-developed ore reserves are given as 124,094,900 tons averaging 2·94% copper. The report says that during the year a programme of prospecting was started to evaluate the economic potential of the oxide zone of the Mindola North Extension and the Nkana Syncline. Surface diamond drilling results have been encouraging, it is stated, but insufficient information is available for an assessment to be made and work is continuing.

BANCROFT MINES reports a profit of £2,744,662 for the year ended June 30 last, during which 51,775 long tons of blister copper was produced. The company's total ore reserves at the end of the year were estimated to be 103,802,400 tons averaging 3·72% copper.

The accounts of RHODESIAN ANGLO AMERICAN for the year to June 30 last show a profit of £7,251,275 and £7,750,006 available, of which dividends equal to 8s. a share require £5,403,535.

Ghana.—With the recent dividend notice shareholders of CONSOLIDATED AFRICAN SELECTION TRUST were informed that the profit for the year ended June 30 last was £2,267,000. Of the £3,004,000 available dividends equal to 3s. a share require £1,672,000.

Australia.—In the year to June 30 last MOUNT ISA MINES treated 812,984 tons of lead-zinc ore and 2,068,275 tons of copper ore and produced 53,300 tons of lead bullion, 59,339 tons of zinc concentrate, 47,620 tons of blister copper, and 94,774 tons of copper concentrate. The consolidated net income of the company and its subsidiaries was £5,929,087, of which cash dividends required £2,381,141. At the end of the financial year the silver-lead-zinc ore reserves were estimated as 25,600,000 tons averaging 7·8% lead and 5·8% zinc, with 5·6 oz. of silver per ton, while those of copper were 24,500,000 tons averaging 3·7% copper. The strike at the property in Queensland has now come to an end.

Earlier this month the RIO TINTO MINING CO. of Australia announced that it had exercised an option to acquire the shares in the Clinton Group of collieries and associated service companies operating in the Burragorang Valley and Lithgow district. A new company, RIO TINTO COLLIERIES PTY., has been formed and it is intended that operations will be carried out in close co-operation with MITSUI AND CO., LTD. It was also announced that an offer had been made to the shareholders of the NATTAI-BULLI COAL COMPANY to acquire all the issued shares in that company and that an undertaking to accept the offer had been received from all the shareholders.

LAKE VIEW AND STAR reports a mining profit of £400,672 for the year ended June 30 last, of which dividends equal to 2s. 6d. a share will require £214,375. From the 764,490 tons of ore milled in the year 166,122 oz. of gold was recovered. The estimated ore reserves at July 1 last are given as 3,688,700 tons averaging 4·94 dwt. in gold per ton.

The accounts of NORTH KALGURLI (1912) for the year to March 28 last show a profit of £160,880 and a total of £219,425 available of which dividends equal to 10½d. a share require £144,375. In the 52-week period covered by the accounts 372,717 tons of ore

was treated and 88,508 oz. of gold recovered. In his statement accompanying the report and accounts the chairman announces the company's intention to go ahead with the installation of its own power plant.

New Guinea.—In the three months to August 31 last BULOLO GOLD DREDGING dredged and sluiced 1,358,715 cu. yd. of ground and recovered 4,108 oz. of gold. The company's profit from operations in New Guinea and Australia for the period is estimated at $35,300.

Malaya.—As was reported earlier by our Correspondent in the Far East the RAUB AUSTRALIAN GOLD MINING CO. has been forced to close down mining operations after 69 years. In a circular to shareholders it is stated that " the necessity to repay the rehabilitation loan has been at all times a heavy burden on the company, taking all of the slender cash resources which otherwise would have been available to carry out mine development work and to modernize mining equipment."

In his address to shareholders of SUNGEI BESI MINES at this month's annual meeting the chairman referred to the success of the new treatment plant and said that its capacity is being extended to handle the much increased yardage which will come from the mine due to the installation of a new 120-litre bucket-wheel excavator. The work, he says, has made good progress and it is expected that it will be completed by the time the new excavator has finished its trial run. Sungei Besi's profit for the year to March 31 last was £239,856, from the production of 1,007 tons of tin ore.

In the year to June 30 last AYER HITAM TIN DREDGING produced 2,056 tons of tin concentrates and made a profit of £377,434.

PAHANG CONSOLIDATED produced 2,411 tons of tin concentrates in the year to July 31 last, 197,000 tons of ore being milled. Operations resulted in a profit of £222,583, the accounts showing £263,609 available, of which dividends equal to 1s. 9d. on the ordinary stock require £218,662. The company's ore reserves at July 31 last were estimated to be 384,134 tons.

India.—The report of the CENTRAL PROVINCES MANGANESE ORE COMPANY for 1960 shows a profit of £255,552 and a total of £552,009 available. Of this amount £275,000 is required for dividends equal to 1s. 10d. per stock unit, free of tax, while £10,000 has been placed to reserve and the balance of £267,009 carried forward.

Mexico.—In his report accompanying the report and accounts of the FRESNILLO COMPANY for the year to June 30 last the company's president, Mr. N. Mason Smith, Jr., in reporting a loss of $771,000 for the year, against a profit of $425,000 for the previous fiscal year, points out that there were several contributing reasons for the year's poor financial results. The major portion of the loss can be charged to the expensive seven-week strike at the Naica mine, while the latter half of the year showed the effect of the wage increases in the new labour contracts at all the properties. Finally, he says, there was the $3,878,000 (net) paid to the Mexican Government for export and production taxes. Mr. Smith goes on to say that the Fresnillo properties are now under joint Mexican-United States ownership. The benefits accorded by Mexican law to mining operations thus " Mexicanized " will in large measure alleviate the strangling effect of the production and export taxes and will, it is believed, assure profitable operation.

Peru.—The operations of the LAMPA MINING COMPANY for the year to June 30 last resulted in a profit of £47,860. With the sum brought in and other items there was £67,135 available, of which dividends equal to 20% require £24,500. In the year 3,131 metric tons of matte was produced, containing 1,376 tons of copper and 458,579 oz. of silver.

Cyprus.—The accounts of the ESPERANZA COPPER AND SULPHUR COMPANY for the year ended March 31 last show a profit of £1,621, which reduces the debit balance brought in to £76,884. The concentration plant of the subsidiary, the CYPRUS SULPHUR AND COPPER COMPANY, treated 224,322 tons of ore in the year and produced 9,827 tons of copper concentrates and 19 tons of cement copper.

Portugal.—In the year to March 31 last BERALT TIN AND WOLFRAM produced 2,079 long tons of wolfram concentrates and 53 long tons of tin concentrates. Operations resulted in a profit of £105,394. In his review of operations given at the annual meeting last month the chairman, Sir Christopher Bullock, said that close attention was being paid to improvements in mining technique and to increasing mechanization. The scraper units previously installed were supplemented early in 1961 and further units would shortly be delivered to the mine. It is hoped eventually to eliminate manually-operated stopes altogether.

Earlier this month shareholders of MASON

AND BARRY were informed that the company had struck, in the neighbourhood of Mina de S. Domingos, and at a depth of 123 metres, 3·4 metres of solid purites " with very satisfactory copper and sulphur content."

United Kingdom.—Last month the LAPORTE INDUSTRIES group announced that it was establishing in Derbyshire a plant with an initial annual capacity of 20,000 tons of acid-grade fluorspar, between 6,000 and 8,000 tlo:s of barytes, and 1,000 tons of lead The pant is at the site of the CUPOLA. MINING AND MILLING COMPANY, a company acquired last year and whose operations are carried out close to those of GLEBE MINES, LTD., at Eyam, Derbyshire. Glebe Mines can now successfully separate the three economic minerals (fluorspar, barytes, and lead) to a high degree of purity and the new plant follows a similar pattern. Production is expected to begin by the middle of next year. In the same part of Derbyshire core drilling is now in progress at Longstone Edge, the additional area acquired last year. It is already apparent, it is stated, that very considerable ore reserves exist in this deposit, which has a great future potential.

Consolidated Gold Fields of South Africa.—The accounts of the Consolidated Gold Fields of South Africa for the year to June 30 last show a profit of £4,180,033 after providing for taxation. Ordinary dividends equal to 5s. a share require £1,600,674. Last month the company announced its intention to make an offer of ordinary shares at a price of 30s. a share to its ordinary shareholders in the proportion of one new ordinary for every 10 held.

DIVIDENDS DECLARED

*Interim. †Final.

(Less Tax unless otherwise stated.)

***Ampat Tin Dredging.**—9d., payable Dec. 29.

†**Anglo-Huronian.**—25 cents, payable Jan. 24.

***Anglo-Transvaal Consolidated.**—1s.

†**Associated Manganese Mines of S.A.**—2s. 9d.

†**Ayer Hitam Tin Dredging.**—9d., payable Feb. 2.

†**Consolidated African Selection Trust.**—2s. 3d. payable Jan. 5.

Consolidated Co., Bullfontein Mine.—Half-yearly 6 cents, payable Jan. 27.

***Falconbridge Nickel Mines.**—60 cents and 25 cents, payable Dec. 12.

†**Fresnillo Co.**—10 cents U.S., payable Jan. 5.

Griqualand West Diamond Mining Co.—Half-yearly, 28·5 cents, payable Jan. 27.

†**Messina (Transvaal) Development Co.**—8 cents, payable Jan. 15.

***Nchanga Consolidated Copper Mines.**—2s. 6d., payable Feb. 1.

New Jagersfontein Mining and Exploration Co.—Half-yearly, 5 cents, payable Jan. 27.

†**Phoenix Mining and Finance.**—3s., payable Dec. 19.

***Preston Mines.**—$1·00, payable Dec. 28.

***Rambutan.**—6d., payable Dec. 8.

†**Rand Selection Corporation.**—20 cents, payable Jan. 17.

***Rhodesia Broken Hill Development.**—5d., payable Feb. 1.

Rhokana Corporation.—Pref. 2¾%, payable Dec. 29.

***Rio Algom Mines.**—$1·50, payable Dec. 27.

***Selection Trust.**—3s., payable Jan. 5.

***Siamese Tin Syndicate.**—1s., payable Dec. 15.

†**South African Townships, Mining, and Finance Corporation.**—15 cents, payable Jan. 17.

***Southern Kinta Consolidated.**—6s., payable Dec. 29.

†**Sungei Besi Mines.**—9d., payable Jan. 31.

Sungei Way Dredging.—†10% and *10%, payable Jan. 1.

Tanganyika Concessions.—Pref. 4%.

***Tonkah Harbour Tin Dredging.**—5s.

***Union and Rhodesian Mining and Finance.**—1d.

***Union Miniere du Haut-Katanga.**—600 B.Fr.

†**United African Explorations.**—10%, payable Dec. 19.

METAL PRICES

Dec. 7.

Aluminium, Antimony, and Nickel per long ton; Chromium per lb.; Platinum per standard oz.; Gold and Silver per fine oz.; Wolfram per unit.

	£	s.	d.
Aluminium (Home)	186	0	0
Antimony (Eng. 99%)	230	0	0
Chromium (98%–99%)		7	2½
Nickel (Home)	660	0	0
Platinum (Refined)	30	5	0
Silver		7	1¾
Gold	12	10	1¾
Wolfram (U.K.)		—	
(World)		4	11 6

Tin, Copper, Lead, Zinc } See Table, p. 364.

Structural Control of Mineralization in South-West England

R. H. T. Garnett, A.R.S.M., B.Sc., D.I.C.

The author stresses the important influence of the cross-courses

With the present high level of the price of tin, and the favourable long-term prospects, interest is being revived in south-west England, particularly in Cornwall, as a potentially more important tin-producing area. Several exploration programmes are being commenced both in the neighbourhood of abandoned mines and in districts which have been relatively unexplored in the past.

Cornwall is one of the major mineralized fields of the world, possessing a very high concentration of tin and copper lodes within a relatively small area, but there is a surprising lack of knowledge concerning the economic geology of the deposits. For detailed information on the majority of the mines and districts it is necessary to rely upon local hearsay, old plans and sections, and private reports. The *Memoirs* of the Geological Survey and a number of other publications during the 20th Century, including that of Dines (1956), are very dependent for any details of the economic geology upon the work of 19th-Century geologists—such as, Henwood (1843) and the publications dealing with individual mines in the *Transactions* of the Royal Geological Society of Cornwall.

A regional control of mineralization in the area by structure, temperature, and stratigraphy has always been recognized. The effect of a localized structural control, which is of paramount importance, has not always been established, however, although many writers have observed that the tin and copper content of the lodes was affected by changes in their dip and strike.

Approximately normal to the tin-copper lodes, the majority of which strike between E.–W. and N.E.–S.W., is a series of apparently less frequent N.–S. fissures. When infilled with quartz they are known as cross-courses and were often referred to in old reports as " cross-bars," " cross-gossans," " cross-lodes," and " cross-veins." Alternatively the terms " trawns " and " gossans," the latter not to be confused with a lode outcrop, were employed to denote a quartz-filled cross-course in the St. Ives and St. Agnes districts, respectively. In the St. Just area the lodes trend, with a wide variation, N.W.–S.E. Numerous steeply-inclined faults strike between N.–S. and N.E.–S.W. and when infilled with quartz are known as " guides." Clay-filled fractures, or faults, are termed " flucans " and are not to be confused with " slides," which are generally parallel in strike to the lodes.

Hosking (1949) outlined the more important theories concerning the origin of the lode fissures. They were considered by the majority of the writers on the area to have been formed by the enlargement of a pre-existing regional fracture system which enveloped both the granite and the country rocks of " killas " and " greenstone " and the formation of new fractures with an orientation controlled by the earlier set. Similarly the origin of the cross-courses has been considered in conjunction with a regional set of roughly N.–S. fractures. On the evidence of their quartz and mesothermal mineral infilling and the fact that they fault the lodes, cross-courses have been regarded as having been formed after the lodes. Hill and MacAlister (1906) and Dines (1956) considered that they were Tertiary and stratigraphic evidence in east Cornwall and Devon supports this view. However, a major fracture is easily propagated in overlying strata as a continuation in strike of a pre-existing fracture at depth. Such evidence dates the age of enlargement and infilling of the fracture and not its age of original formation in older rocks in the vicinity of mineralization.

Especially in eastern Cornwall and Devon, major cross-courses sometimes provided an economic source of lead, zinc, and iron. Otherwise they aroused little interest and by deflecting the lodes they were more of a hindrance to underground development. Tabulated observations on the distance

through which they faulted a lode were provided by Henwood, who demonstrated that the differing horizontal components of movement of the lodes and dykes could not be accounted for by simple normal and reverse faulting. He considered that only the acceptance of oblique, and in some cases rotational, faulting could adequately explain some of his observations. The maximum horizontal component of movement of one cross-course has been recorded to exceed 400 ft., although an average value is of the order of a few fathoms. Many of the cross-courses extended for several miles, whilst others apparently ceased to exist between adjacent lodes.

Because of the undisputed view that the cross-courses post-dated the lodes it was assumed that they could not have exerted any structural influence upon the extent and degree of mineralization within the lodes. However, despite the lack of an explanation many of the early writers noted that some of the cross-courses appeared to influence the tin and copper values. Variations were observed in the lodes as they converged with a cross-course and Henwood recorded that the Malkin lode in Ding Dong mine changed in structure and mineralogy upon approaching a " trawn."

Many lodes proved to be enriched along the line of their junction with a cross-course. According to Carne (1822) there were two instances in Botallack and Parknoweth mines where " very rich courses of tin have been the result of such intersections." Henwood remarked that " not a few of the larger and richer bunches, both of tin and copper ores, have occurred in the immediate vicinity of cross-courses and flucans." Despite these increases in value at intersections the miners were frequently unable, despite widespread trials, to locate the faulted extension of the lode under development. If the extension was found it was often with disappointing results for, as Henwood stated, " frequently has the produce been exclusively found on one side of these intersections, whilst on the opposite side the same lode has been entirely worthless." Notable examples were provided by Wheal Friendship, Wheal Jewel, and Wheal Vor, near Woolf's cross-course.

When contemplating the examination of an old property which has most probably been closed for more than 50 years it is unlikely that any first-hand information may be available. The possible reasons for the cessation of operations and abandonment of the mine and the factors outlined by Trounson (1959) must be considered in detail.

Geophysical and geochemical methods may on occasions in Cornwall be employed to advantage to guide later work, but diamond drillings, from either the surface or underground after unwatering, is the most important exploration technique in Cornwall. Even drilling, as a result of the low core recovery that is obtained in penetrating many of the lodes and the very sporadic distribution of tin values throughout them, provides no basis on which to determine the grade and value of a lode. Under ideal circumstances diamond drilling will indicate no more than a lode's presence and any possible further conclusions may be based only upon geological evidence extracted from the core.

When investigating an old property diamond drilling may be employed to examine proved lodes in depth, to locate their possible extensions, or to search for adjacent parallel lodes. Available plans and sections often indicate that development on a lode worthy of investigation terminated in the vicinity of a cross-course, the stoped-out ground extending up to the feature but not beyond. An obvious attraction to the exploration engineer is to drill on the other side of the cross-course for the lode extension which may be expected to carry economic values. By employing examples from Geevor mine in the St. Just district the writer stresses that such a procedure should be attempted with caution, since a lode cannot always be expected to exist on both sides of a cross-course.

At Geevor mine the lodes and cross-courses (guides) occupy regional fractures which were originally formed before the first phase of tin-copper mineralization. Infilling of the lode fissures and cross-course fissures was completed in several stages, each accompanied and separated by periods of stress change which resulted in movement along and enlargement of the pre-existing fissures. Complete infilling of the lode fissures was usually completed before the commencement of the infilling of the cross-course fissures. In the following discussion a fissure, which when infilled qualifies for the term lode, is a potential lode prior to infilling and is therefore termed a lode fissure. The same form of nomenclature is applied to the cross-courses.

Between successive pairs of steeply-inclined cross-course fissures which extended throughout the granite and country rocks blocks of ground moved alternately up and down relative to one another. Individual

blocks possessed a width, defined by the spacing of the cross-course fissures, varying between 1,000 ft. and 5,000 ft., the longer horizontal axes of the blocks coinciding in direction with the strike of the fissures. The oblique movement of the order of 10 ft. to 20 ft. resulted in a horst and graben structure, as shown diagrammatically in Stage 1 of Fig. 1. Cross-course fissures are mainly vertical and were subjected to normal faulting. When steeply inclined in the same direction alternate fissures were subjected to reverse and normal faulting.

Within the uplifted blocks, or horsts, movement took place along the lode fissures through 10 ft. to 20 ft. in the manner shown in Stage 2 (Fig. 1). It was accompanied by mineralization and those lode fissures along which movement took place were infilled to form lodes. When those with the same strike dip in opposite directions normal faulting took place on each. Conjugate lode systems were formed as described by Webb (1947), although sufficient movement to permit mineralization frequently took place on only one set of the system. In Geevor mine the majority of the lodes dip steeply to the southwest and alternate ones were subjected to reverse and normal faulting, enabling the dislocation of wedges of ground to accommodate the maximum stress directed from below.

The direction of movement of the blocks between the cross-course fissures was determined by the same stress distribution as governed the final development of the lode fissures. Those lode fissures—such as, L_2—possessing a line of intersection with the cross-course fissure coinciding with the direction of displacement of the blocks between the cross-course fissures suffered no apparent horizontal displacement. In such a case movement was more easily activated in the graben on the other side of the cross-course fissure and the lode fissure became mineralized in both directions.

The main tin-copper lode mineralization phase did not affect the cross-course fissures during Stage 2 (Fig. 1), since the alignment of the minimum principal stress normal to the lode fissures allowed only the latter to be opened for mineral deposition. Nevertheless mineralization has been observed to extend for a few feet along a cross-course on either side of a lode. Referring again to Fig. 1, there was a tendency for the cross-course fissure C_3 to impound the mineralizing solutions ascending in lodes L_1 and L_3 since the relative

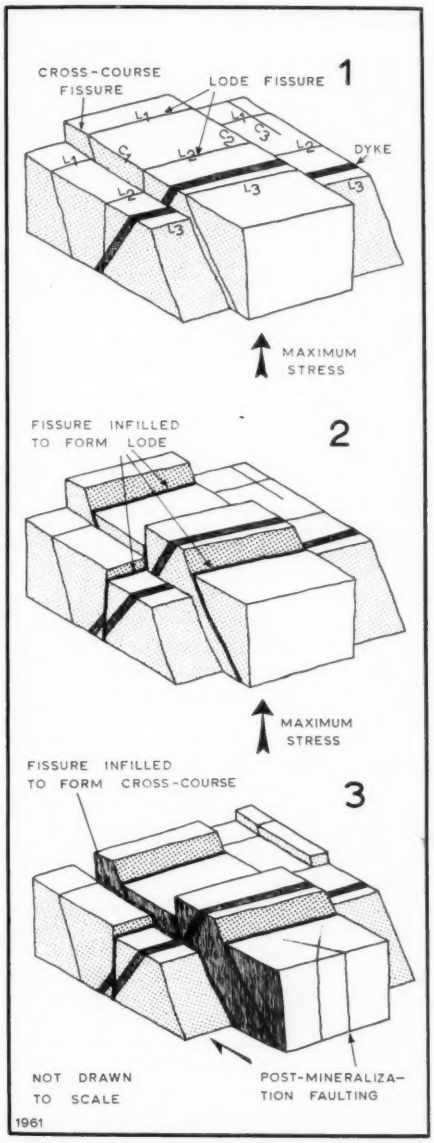

Fig. 1.—Diagrammatic Representation of the Structural History of the Cross-Courses and Tin-Copper Lodes.

movement of the lode fissure walls was terminated against C_3. A narrow zone of high values was sometimes created in a lode at the intersection with a cross-course fissure and to one side only of the latter. In the case of these

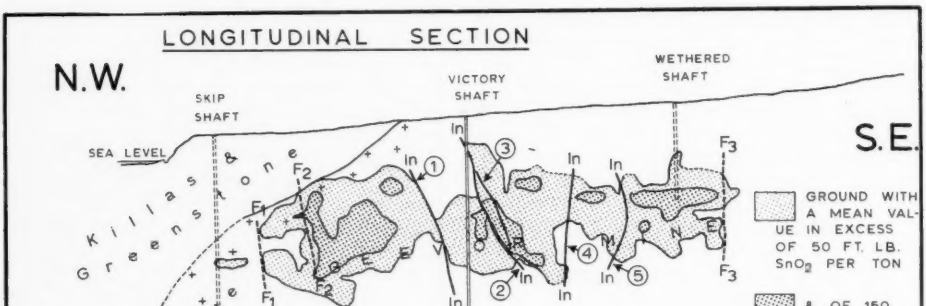

Fig. 2.—Longitudinal Section through the Workings of Geevor Tin Mine.

lodes their line of intersection with the cross-course fissure did not correspond with the direction of movement of the blocks.

Subsequent displacements along both the lodes and cross-course fissures under the same stress distribution resulted in further phases of mineralization. The final phase, consisting of quartz, calcite, and siderite, etc., occurred in conjunction with a relaxation of the stresses. A subsidence of the uplifted blocks between the lodes marked the termination of the tin-copper phases.

After a long period of quiescence a maximum horizontal stress initiated tear faulting along the cross-course fissures and post-mineralization conjugate faults along newly-formed fractures as shown in Stage 3 of Fig. 1. Relaxation of the same stress caused infilling of the cross-course fissures with quartz and low-temperature mineral assemblages, especially where the local strike direction deviated from the average. Some of the lodes were also affected by this final mineralization phase normally associated with the cross-courses.

In Geevor mine late horizontal slickensides were superimposed on the lode constituents during the period of formation of the tear faults. In both the lodes and the cross-courses horizontal slickensides tended to erase earlier vertical slickensides originating during Stage 2 (Fig. 1). Even later disturbances, with no associated mineralization, produced movements in the planes of the lodes and cross-courses, which sometimes resulted in the deflection of a cross-course by a lode.

In the St. Just district cross-course fissures were usually not infilled unless their strike varied extensively, like that of the North Levant Lode, from the average. They appear as major faults or fault zones about 10 ft. wide. Mineralization in Geevor mine was terminated between two major faults which now give a first impression of being major post-mineralization tear faults with a horizontal throw up to 10 ft. These denote the limits of the original horst formed during Stage 1 (Fig. 1), when the block now containing the economically-mineralized lodes was uplifted through a height of the order of 10 ft. A longitudinal section through the mine, provided in Fig. 2, illustrates the extent of the workings and the value of the ground blocked out on the No. 2 Branch, North Pig, and North Lodes.

The first phase of tin mineralization in the mine was associated with intense wall-rock alteration, including tourmalinization and reddening of the granite. Deposition of cassiterite was extremely sporadic and occurred throughout the majority of the lodes in the western half of the property. An earlier or simultaneous relative movement of the walls of a lode was not necessary for

deposition to take place and, considered alone, the first phase rarely resulted in economic ground. In some circumstances the first phase of tin mineralization and the early wall-rock alteration took place before any movement between the cross-course fissures. Consequently the located extensions of any lodes in the usually unmineralized graben structures often contain traces of cassiterite and possess substantial wall-rock alteration.

In the western part of the mine the first phase of tin mineralization in the No. 2 branch lode was not impounded by the most westerly of the two faults, F_1, and formed a small patch of values around level 12 and in line with the skip shaft of Levant mine. A second tin mineralization phase, indicated loosely by the 50-ft.lb. contour line, was confined by F_1 as a result of movement having already taken place in the plane of the latter. The 150-ft.lb. contour line indicates a third phase terminated by the fault F_2. The fissure resulting in F_2 was in existence before the commencement of the second phase of mineralization. Movement along it took place after the termination of the second phase, upon which it therefore exerted no structural control, and before the third phase.

Both the second and third phases were subjected to a local control by the granite surface through a combination of temperature and structural effects. Extensive tin and copper mineralization was exploited until 1930 in Levant mine to the west, where the lodes were situated almost entirely in the country rocks of " greenstone " and " killas." The cessation of economic tin mineralization in Geevor mine in the vicinity of the granite contact was due more to the existence of the two major faults, one of which terminated the mineralization on three other parallel lodes, rather than to any direct effect resulting from the situation of the granite contact or the presence of " greenstone " in the adjacent country rocks. A limit of economic tin mineralization in the eastern part of Levant mine is marked by a well-developed cross-course, there being a relatively barren block of ground between the latter and the major fault F_1 of Geevor mine.

In the eastern part of Geevor the first phase of mineralization is not evident, since it was locally developed near the granite contact. Vertical movement took place on the major eastern fault, F_3, before the second tin mineralization phase commenced and both the second and third phases, indicated loosely by the 50-ft.lb. and 150-ft.lb. contour lines respectively, were confined to the west as a result.

With the exception of the first, the main tin mineralization phases were executed for the most part under prevailing conditions of variable compression from all directions and were impounded by the cross-course fissures or faults. During the latter part of Stage 2 the influx of quartz, calcite, and siderite was accompanied by an all-round stress relaxation and the partial subsidence of the uplifted portions of ground between adjacent lodes. In the Geevor mine there are only small variations in the dip of the lodes where adjacent to the cross-course fissures. Since the direction of relative movement of the horsts and graben was in the same direction as the mean line of intersection of the cross-course fissures and the lode fissures there was little apparent horizontal displacement of the latter during Stage 1. Throughout the relaxation phase many of the lode fissures on the relatively unmineralized side of the cross-course fissures which had hitherto been subjected to the first sporadic tin mineralization and early wall-rock alteration only were infilled with the quartz, calcite, and siderite, etc.

In many of the mining districts there is a wide variation in the strike of the lodes. To many the term " caunter lodes " was applied with conflicting estimations of their age relative to those lodes possessing what was regarded as the predominant strike. Examples have been provided by many writers of the faulting of one lode by another and of the mineral infilling of one passing continuously through that of the other. The relative age of infilling of two separate intersecting fractures is not conclusive evidence of their relative age of fracture formation, nor is it indicated conclusively by any deflection imposed upon one by the other. The majority of lodes were subjected to two or more phases of infilling, each accompanied by movement. When two lodes intersected and the periods of mineralization in one were out of phase with those in the other, mutual interference with the extent of mineralization in each took place, especially when the strike differences between the two were large.

The simplest case of two intersecting lodes, each subjected to only one phase of mineralization coincident with movement, can be considered. If mineralization took place in both lodes simultaneously enrichment resulted at the intersection due to increased fracturing and the lodes are continuous on both sides of the junction. If each lode underwent

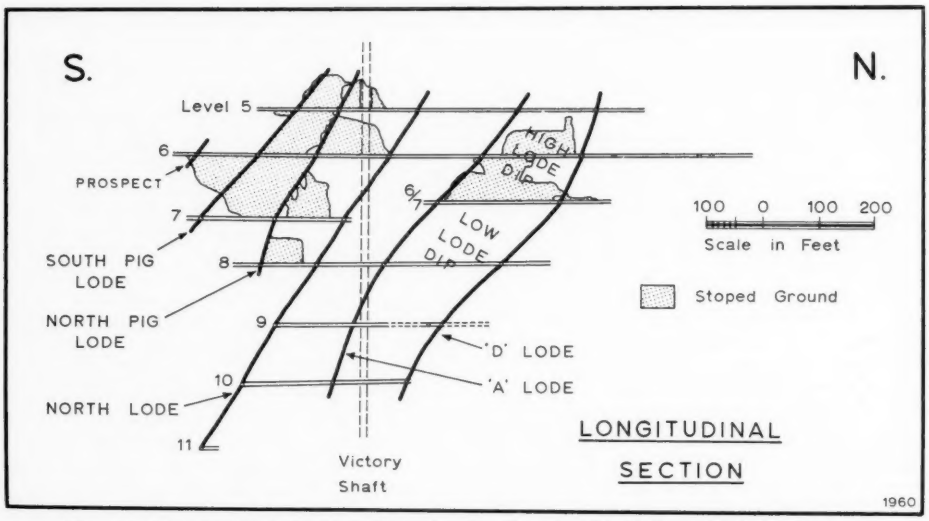

Fig. 3.—Longitudinal Section through the Hanging-Wall Branch Lode, Geevor.

mineralization at different times and on each occasion no influence was exerted by one lode upon the other there will be no appreciable change in the tin values that may be attributed solely to the influence of the intersection. Both lodes would tend to be continuous beyond the intersection on each side. When mineralization occurred on the two intersecting lodes at different times and structural interference took place, more usually only one lode proves to contain economic values on the other side of the intersection. Complications arise through the occurrence of more than one phase of mineralization and movement on each lode.

Some of the effects of mutual interferences at lode intersections in Geevor mine are indicated in Fig. 3, which shows the stoped ground on the easterly-dipping Hanging-wall Branch lode; the latter makes an angle in plan of about 70° with the majority of the lodes. Although it approximates towards the strike of the local cross-courses it does not possess any of the mineral assemblages associated with them and has been locally stoped on the upper levels. Five major south-dipping lodes were intersected by the Hanging-wall Branch lode. The tin mineralization of the " D " lode was impounded by and confined to the west of the Hanging-wall Branch lode. That of the " A " lode and the North lode was enriched in the upper levels. There was no control exerted upon the mineralization of the North Pig lode, while that of the South Pig lode in the Victory section was impounded and stoping confined to the west.

Selective movement on the Hanging-wall Branch lode enabled the controls described to operate. The extent of the mineralization on the latter was influenced by the various lodes and the majority was confined, as indicated by the stoping, between the " D " and " A " lodes and between the South Pig and North lodes. Some effects of temperature zoning are apparent in the stoping pattern. Mineralization of the Hanging-wall Branch lode between the " D " and " A " lodes was associated with a downward relative movement of the hanging-wall for a few feet, which resulted in the highest tin values being confined to the steepest parts of the lode. The values which might be expected between levels 6/7 and 10 are absent, owing to the low lode dip in this region below level 6/7.

The more important aspects of this work are the practical applications. When old plans and sections of abandoned mines indicate that the " blocked out " or stoped portions of a lode terminate at a major cross-course or fault caution should be applied in any scheme to search for what may be thought to be the simple faulted extensions of the economic lodes already exploited on the other side of the cross-course. Resort should not be had completely to exhaustive diamond drilling.

It was not common practice to indicate all the cross-courses and major faults encountered in a mine on the plans and sections of the

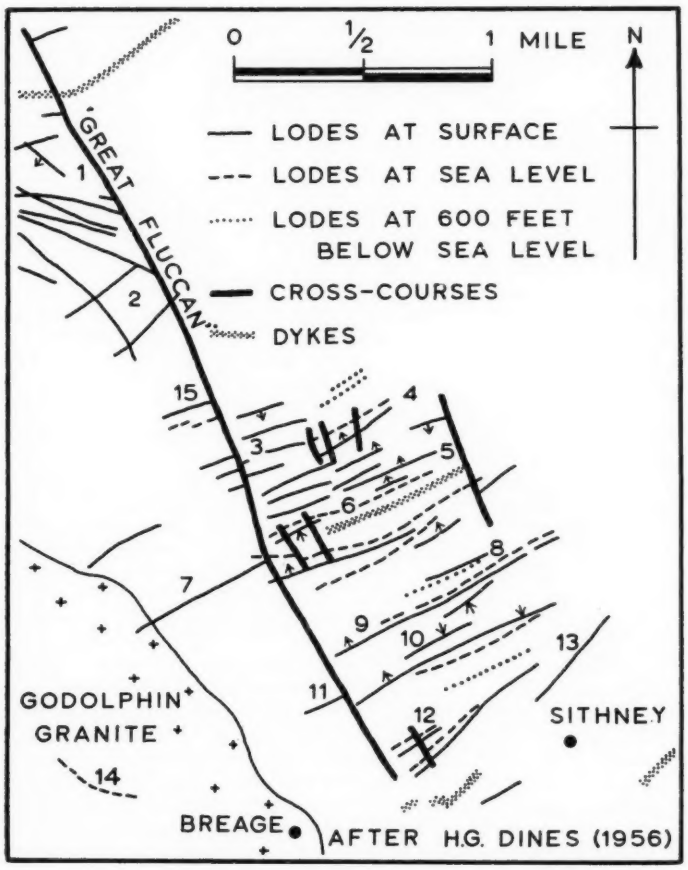

Fig. 4.—Part of the Breage Mining District, Cornwall.

(1) Godolphin ; (2) East Great Work ; (3) Polladras ; (4) Penhale Vor ; (5) Gwin and Singer ; (6) Vor ; (7) Carleen ; (8) Sithney Metal ; (9) Metal ; (10) Carnmeal ; (11) Emma ; (12) Great Fortune ; (13) Sithney Carnmeal ; (14) Trevena ; (15) Polrose.

underground workings. Since cross-courses provided easier-breaking ground and were usually normal in direction to the average lodes they were frequently employed as a site for cross-cuts. The exact position of a cross-course is often therefore indicated by cross-cuts possessing sinuous outlines in plan. If the presence of a cross-course at the extremity of a lode is proved or indicated by the presence of a cross-cut from one of the development ends it is likely that it has exerted a local structural control upon the extent of mineralization within the lode in question. After an initial investigation by diamond drilling either from the surface or adjacent underground workings the second stage of the exploration should concentrate more thoroughly upon a search for undiscovered parallel lodes, which may also be subjected to a control by the same cross-course. A majority of Cornish mine plans indicate a profound lack of exploratory cross-cuts and non-outcropping parallel lodes were frequently found only when they existed as branches of those that were being developed.

If a structural control by cross-courses is suspected or confirmed they should always be considered in pairs, each demarcating the limits of successive horsts and graben. If a block of ground is encountered in which strongly-developed sub-economic lode fissures occur a search should be conducted for an adjacent block, indicated by a further cross-course along the strike of the lode fissures in which movement and consequent mineralization has taken place.

A very strongly-developed and long lode fissure often terminated the movement of the blocks between, and along the strike of, cross-course fissures. The movement of blocks on

opposite sides of the lode fissure could take place at different times. A result of this rather complicated process may be appreciated more readily if the reader imagines a chess-board as representing a mineralized area in Cornwall. The lines running N.–S. on the board denote the cross-course fissures and those running E.–W. represent the more numerous lode fissures. As a result of stress distributions before and during the mineralization period, irregular blocks of ground represented by the black squares rose relative to the white squares. In the black squares further movement occurred which initiated the mineralization of the lode fissures to form lodes.

When a cross-course fissure exerted a structural control upon the tin mineralization within an intersecting lode the values do not decrease suddenly. Occasional rich portions are located at the intersections, but more usually the values diminish gradually over a distance of the order of 100 ft. Wall-rock alteration phenomena and late gangue mineral infillings were not always controlled by the cross-course. Therefore the lode, at an intersection with a cross-course, although being subjected to a structural control, may not demonstrate any change in its appearance over a short distance and is often identical in outward character on both sides of the cross-course during an underground examination. Only a detailed mineralogical and structural study, conducted in conjunction with systematic sampling, over a distance of about 100 ft. on each side of the cross-course on one level indicates whether or not the lode is worthy of major development on additional levels. The value and character of a lode at the intersection with a cross-course are no criterion for judging its overall production potential.

If, during development of a productive lode on several levels, a cross-course or major fault is encountered development should proceed beyond the cross-course on only one level—that most likely to disclose high values, judging by those on the already-developed side. If the first phase of mineralization was not impounded by the cross-course fissure then the tin values encountered are usually of a grade sufficient to encourage continued development, but rarely result in stoping ground.

No exploratory cross-cuts or diamond-drill holes should be sited on, or in the immediate vicinity of, cross-courses or major faults when the direction of the contemplated cross-cut or hole is approximately the same as the strike of the cross-course or fault. They should, where possilbe, be sited equidistant between two such features, against the centres of fully-developed lodes or against the richest portions of the lodes; a rule which was applied to advantage in Cornwall before 1850.

Cross-courses and major faults are usually normal to the mean-strike direction of the lodes. When this is not the case the exploration cross-cuts and diamond-drill holes should, within reason, be aligned in the same direction as the cross-courses and major faults and not necessarily normal to the lodes. A rapid scrutiny of mining records produces many examples of districts in which the above principles may be applied with advantage. One such area, illustrated in Fig. 4, is that to the north of Breage, on the north-eastern flank of the Godolphin granite, and in which is situated the celebrated Wheal Vor.

Proof that the controls outlined above have operated in one district should not be regarded as a guarantee that the same effect has occurred throughout the south-west, or even throughout Cornwall. Each mining district possesses individual characteristics of mineralization and structure and should be considered on its own merits. It should also be remembered that any mine plan shows only the lodes that have been discovered and not all those that actually exist. Nevertheless it is anticipated that this brief outline of one of the many forms of local structural control of mineralization in the south-west, the knowledge of which is utilized in all underground exploration at the Geevor tin mine, may be applied profitably at additional properties in the future. Indiscriminate diamond drilling and exploration resulting from the re-opening of old properties will only result in a repetition of past errors. Exploration, which can only be directed by a geologist provided with the necessary appreciation of the mining problems involved, must be conducted with a complete awareness of all the features of localized structural control of the tin-copper mineralization.

Acknowledgment.

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Efficiency Index for Milling Calculations

K. K. Majumdar [1]

The author suggests a new formula for a single-product circuit

Introduction

In ore-dressing operations, especially when the method of beneficiation is flotation, it is desirable to use an efficiency index to select the best result from a set showing the grade of the concentrate and the corresponding recovery. Several proposals have been made in the past to combine the numerical values of recovery and ratio of concentration, or ratio of assay of concentrate to assay of feed or tailing, which may be called an efficiency index. None, however, has proved to be entirely successful.[2]

It is proposed to use a new formula for efficiency index for a single-product circuit, combining recovery and ratio of enrichment as follows :—

Proposed efficiency index

= Recovery × ratio of enrichment.

$$= 100 \cdot \frac{c(f-t)}{f(c-t)} \times \frac{c}{f}$$

where

c = assay of concentrate,
f = assay of feed,
t = assay of tailings.

As an example of the usefulness of the above formula the efficiency indices have been calculated according to the above formulae for products obtained by flotation of a low-grade uranium ore using different collectors. The results are shown in Table 1.

Table 1

Sl. No.	Reagents.	Feed Assay (% U_3O_8).	Assay of Conc. (% U_3O_8).	Recovery (%)	Efficiency Index (Proposed).
(1)	Oleic acid	0·055	0·148	80·9	217·7
(2)	Sodium oleate	0·055	0·094	81·6	139·4
(3)	Petroleum Sulphonate	0·055	0·083	87·0	131·3

It will be seen from Table 1 that the highest efficiency index is indicated for case (1), using oleic acid as the reagent. It will be admitted that although the recovery is slightly lower than case (2), where the efficiency index is much lower than that of case (1), the high efficiency index is due to the higher assay of the concentrate, or, in other words, because of the higher ratio of enrichment. Of the two factors—*i.e.*, recovery and ratio of enrichment which have been considered in the proposed efficiency index—the ratio of enrichment plays a very important part. From a metallurgical point of view also it is expected that the cost of production of the finished metal in case (1) by metallurgical

[1] Metallurgy Division, Atomic Energy Establishment, Trombay, Bombay-71, India.

[2] TAGGART, A. F. "Handbook of Mineral Dressing." 1956, pp. 19–195.

Table 2

Flotation of a low-grade uranium ore from Bihar by different reagents

Reagents.	*Assay of Feed (Calculated)* (% U_3O_8).	*Assay of Concentrate* (% U_3O_8).	*Recovery* (%)	*Ratio of Enrichment.*	*Efficiency Index (Proposed).*
(1) Petroleum sulphonate . .	0·089	0·145	81·4	1·63	132·6
(2) Petroleum sulphonate : oleic acid 80 : 20. . . .	0·089	0·149	90·9	1·67	151·8
Petroleum sulphonate : oleic acid 60 : 40. . . .	0·100	0·186	86·4	1·90	164·2
Petroleum sulphonate : oleic acid 40 : 60. . . .	0·087	0·162	81·3	1·86	151·2
Petroleum sulphonate : oleic acid 20 : 80. . . .	0·082	0·165	80·6	2·02	162·9
(3) Oleic acid	0·086	0·166	80·5	1·94	156·2

operations would be much lower than case (2) because of smaller bulk has to be treated.

In order to emphasize the usefulness of the proposed efficiency index further examples are cited in Table 2.

In it is also possible to select certain results which are superior to others by applying the proposed efficiency index. Without a proper efficiency index, it is almost impossible to select the best results.

Acknowledgement

The author's thanks are due to Dr. Brahm Prakash, Head, Metallurgy Division, Atomic Energy Establishment, Trombay, for his encouragement in this work.

Iron Ore from Labrador

A note on the shipments recently started from Port Cartier, Quebec

Shipments of iron-ore concentrates have recently been started from the newly-constructed harbour of the Quebec Cartier Mining Company at Port Cartier on the northern shore of the St. Lawrence River, Canada. The port has been built specially to handle the concentrates produced from the company's newly-developed iron-ore mines in the south-western extension of what is known as the Quebec-Labrador Trough, some 200 miles north of the small pulpwood port of Shelter Bay.

With a depth of 50 ft. below low tide Port Cartier Harbour is one of the deepest in Canada and has been "carved" into the shore line. It will be capable of handling the largest ore carriers afloat today and even the larger ore carriers contemplated in the future. Its construction has involved the excavation and removal of over 10,000,000 tons of rock. Essentially it is a large 2,500 ft. by 450 ft. basin cut into the sheer rock with a narrow 500 ft. inlet and walls or breakwaters extending into the open water to cut off the swell action and to provide safe and protected berths for five ships which can enter the harbour during winds of up to 40 m.p.h.

The new town of Port Cartier, when fully developed, will absorb the existing small port of Shelter Bay. From the port the concentrate is to be shipped in ore carriers to Philadelphia for the Fairless Works of United States Steel, the parent company of Quebec Cartier, and to steelworks in Detroit, U.S.A. The handling facilities are capable of loading up to 5,000 tons to 6,000 tons of ore an hour into the ships' holds and some 8,000,000 tons of concentrate a year may be being shipped by 1963.

In winter efforts are to be made to keep the port free of ice by compressed-air bubbles

Port Cartier Harbour under Construction.

released from pipes on the bed of the harbour. Drying equipment has also been installed at the automated ore-handling plant to keep the moisture content of the concentrates to 0·5% to prevent freezing of the ore in winter. At all times, however, a filtering operation will keep the moisture content down to 3% to facilitate handling. The automatic equipment is capable of unloading ore rail wagons at a rate of one every 90 sec. There is covered storage capacity at the port for 400,000 tons of material.

Supplying the ore for shipment is what is claimed to be the world's largest concentrator at Gagnon, at the company's mining headquarters, 200 miles to the north, which has been designed to handle 20,000,000 tons of ore and to turn out over 8,000,000 tons of high-grade concentrate a year. At the time of writing the concentrator is working at about 25% of full capacity, delivering about 6,000 tons of 70% concentrate per day. Production will be gradually stepped up over the coming months.

To connect the mining area with the port an entirely new railway has been constructed through some of the most difficult country in the world.

Tanganyika Territory

The Mines Division of the Ministry of Commerce and Industry has continued to promote prospecting by the Africans themselves and has extended courses for that purpose, particularly in their own localities. Of the 34,000 square miles examined by the Western Rift Exploration Co., Ltd., rights have been retained over 1,300 square miles for further more detailed investigation. Consolidated Gold Fields of South Africa, Ltd., has retained prospecting rights over the Minjingu Hill phosphate deposit, from which samples of beneficiated ore are being tested. A market review of East African potential requirements is being conducted. Apart from restricted operations in the Musoma district by Tangold Mining Co., Ltd., gold prospecting remains economically unattractive. Mica is still attracting the small worker, while interest in semi-precious stones is developing. An interesting development in technique is that of Williamson Diamonds, Ltd., which has successfully tested the use of a mixture of ammonium nitrate and diesel oil for opencast blasting. This application, which has reduced explosive costs by about 50%, is also being

used by the Kaborishoke tin mine of the Kyerwa Syndicate, Ltd., and seems likely to be extended further in opencast operations. The costs and supply of explosives appears to be a major pre-occupation of the mining industry. Negotiations have been conducted with United Kingdom suppliers with a view to reducing the c.i.f. costs in the territory. Present copper operations are confined to higher-grade zones of what may be an extensive but low-grade deposit in the Pare district, where prospecting by Africans has been fairly active, one prospector having concluded arrangements for shipping 150 tons of ore to Japan. His prospect and another in the Kilosa district is being examined by the Geological Survey. Marketing of ruby and sapphire from the Lushoto district deposit is being investigated. The continued resumption of graphite output from the Lindi district depends on market demand. Exploitation of the Panda Hill (Mbeya Exploration Co., Ltd.) and other pyrochlore deposits depends on success in extraction tests and on marketing conditions. The production of diamonds, gold, mica, and tin concentrates remains the mainstay of the territory's mining industry.

Big Blast on the Golden Mile

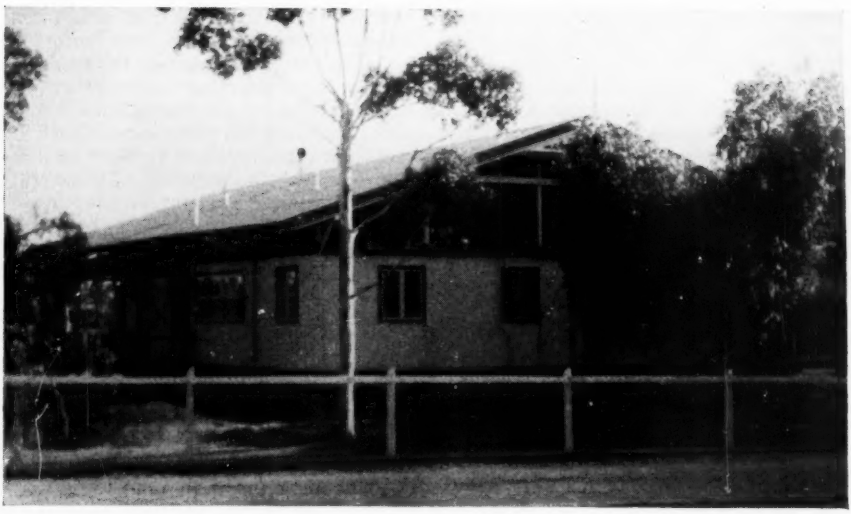
On Saturday, May 6, 1961, a large controlled underground blast was carried out on the Brown Hill mine of the Gold Mines of Kalgoorlie (Aust.), Ltd., 27,000 plugs of 75% gelatine dynamite being fired electrically, using also about 14,000 ft. of Cordtex and 140 short-delay detonators. In all there were nearly 200 cases of explosive of $1\frac{1}{8}$ in. diameter and 27 rolls of the Cordtex. Of the electric detonators used about 80 were for firing explosive to shatter old timber, the remainder being for the ore blast. The exploder was located at the Brown Hill Underlay Shaft about 600 ft. distant.

For many weeks a half dozen miners had been engaged in preparing for this blast, boring long holes on a determined plan. Holes bored totalled 26,000 ft. of long holes and 75% of this distance was charged with the explosive. The ore block blasted extended from 60 ft. below the surface to at least 180 ft. (giving a total of approximately 39,000 tons), while below that again was another block of 6,000 tons which had also to be blasted to allow the upper mass a clear passage to a stope

Old Plant Ruins, Hannans Brown Hill Mine.

on the 350 level and to the mill holes which had already been prepared for the extraction of the broken ore. The old stope on the 350 level was of great size, representing ore taken out during past operations. By mechanized means the newly-broken ore will be taken to the Paringa Shaft and hoisted to be part of the feed for the G.M.K. mills for many months to come. The ore mass blasted appears to have been a kind of excrescence or bunion-like mass on the west side of the lode previously worked and had been apparently overlooked in the earlier operations.

The blast had some spectacular results. About 10 sec. or so after firing a twisting column of red dust spouted skywards from an old shaft nearby. This was quickly followed by a spectacular break-through to the surface and the cloud boiled and hissed as 1,000,000 cu. ft. of air and gas fought for an outlet. A third column shot up 5 min. later, with timber and debris flying, to leave a great hole about 60 ft. (it grew to 80 ft.) in



Health Laboratory, Kalgoorlie : One-time office of the London and Hamburg Gold Recovery Co.

diameter, followed by internal rumblings as the 45,000 tons of shattered rock fell, slid, and subsided to the new resting place. The gaping cavity was right on the foundation lines of the old Brown Hill Company's treatment plant, which commenced operations in 1899 with a Grand Opening Ceremony. To stand on the brink of this new " cut " is to look at a reminder of events of so many years ago, when the old company was ready to produce gold in quantity—after an inauspicious start. Right on the edge of the " cut " are the old furnaces of the London and Hamburg Company's installations—structures of 62 years ago.

On that Opening Day in January, 1899, all the 400 visitors to the new plant were V.I.P.'s indeed and they were treated with lavish and open-handed generosity, being welcomed and catered for by the urbane Dr. Diehl (for the London and Hamburg Co.), the suave W. R. Feldtmann (Brownhill Co.), and the dapper Ernest Williams (Bewick, Moreing, and Co.). When all the visitors had been surfeited with the entertainment at the mine, the sight of piles of rich ore and heaps of tellurides, and with all the wonders and marvels that they were encouraged to examine, they were whisked back to Kalgoorlie's Palace Hotel for a Grand Banquet at which Ernest Williams gave the figures and pronounced a 10s. immediate dividend ; that " brought down the house."

Another point of interest in the blast, and also a reminder of other days, is that around the surface area close to the new openings are the many piles of old mine rubbish—bits and pieces of stone, bricks, iron work, timber—the wastage of past operations. Among all this junk are some pebbles or flints (they can be collected in dozens) which are obviously some of those that were used, once-upon-a-time, in the grinding mills and brought to Western Australia from the south coast of England ; pebbles that had been dropped from the Chalk and worn smooth on the shore by wave action, reminding one of Eastbourne or Brighton. For many years such flints played their constant part in the fine-grinding treatment of the ore of the Golden Mile.

L. G. SPENCER-COMPTON.

Ore-Dressing Notes

(16) *Economics.*

Processing Costs

Cost analyses and the sheets of figures they breed make rather dry reading for the purely technical mill man. However, an article in

the June issue of the *Engineering and Mining Journal* opens with the comment " very few companies are willing to talk very much about their mineral processing costs. And the few who are willing do so only in confidence." The writer would say, rather, that very few operators realize the importance to the field in general of the opportunity to compare broken-down costs per ton. There are many reasons why either of these views may obtain. To the layman sets of figures for different plants which differ markedly in specific matters may seem to brand the more costly operation as inefficiently conducted, while to the expert not specifically concerned with mineral processing, but viewing the affairs of a given mine globally, there may seem no useful basis for comparison with figures for other ores, other extraction rates, other types of flow-sheet, and other end-products.

Both views are right enough as far as they go. Management in modern industry cannot be divided, however, into two watertight compartments—administrative and technical. The administrator relies increasingly on a financial digest of operating costs to show for each accounting period any important change in the use of the company's money. The technical manager uses information worked up from the same global figures to spotlight variances in operating details associated with his sphere of control. If the outlook of both parties is severely confined to considerations of efficiency in their respective fields a high norm can be achieved, with gratifying steadiness all along its production line.

How, then, is the danger of stagnation to be avoided. The requirements of the mining industry are influenced by factors which hardly affect secondary producers and manufacturers and the criteria of what should be published and what kept secret are therefore different. Although there is a certain amount of competition for sales outlets it is not of the same intense nature as that experienced where direct sales to the public are concerned and it tends to affect valuation of marginal ore reserves rather than those of a fairly comfortable profitable grade. Broadly, mineral markets are long-term and mining policies conform to this state of affairs, despite evil memories of recurrent financial crises. Business plans not for glaring exceptions but for norms and the norm in mining is dictated by the viable ore reserve, dependent itself on extraction costs.

Since there is a constant pressure from consumers on the world's always inadequate reserves anything which can be done to increase them is a direct contribution to the stability not only of mining but of commerce in general. First-class brains are as much in demand in mining as in every other industry and the fortunate possessors of such brains can afford to choose their field of activity, their choice being influenced by the stability offered.

There is, then, a general argument in support of policies designed to reduce operating costs by the better use of human intelligence in the choice and deployment of modern engineering resources. Before this can be done there must be a wealth of accurately-produced information from which various methods of doing a given job can be compared in sufficient detail and with the reliability which only cost breakdown over an adequate accounting period can validate. The laboratory and pilot operation can do many things but in the long run a full-scale job, expertly costed, provides the best basis for production research. This means the meticulous collation of correctly-reported operating data with all possible speed. The mill man is always pressing for faster tailings assays so that if anything is going wrong he can get to work the moment the vital facts are disclosed. If he looks beyond this elementary requirement of his craft, however, he will see that this same gathering and appraisal of facts is just as important to every other link in the chain of which he forms an extremely important part. More, his link is meshed intimately with the gathering of ore and its transport to his mill on the one side and to the specifications for a suitable product for transfer from mill to smelter or customer on the other.

The article already mentioned does not lend itself to abstracting as it is concerned with cost data on a number of operations in which various ways of tackling the job have been used. Scattered through the literature are many bits of costing information which ought to be brought to a focus and made comparative, for education, in this case, would work to remove the veil of secrecy from figures for individual operators where no overriding justification could be sustained for hiding knowledge which would benefit the industry as a whole. At the end a much sounder knowledge of the way to mine, transport, and treat ore for any given size of operation might be hoped for, as well as any special set of conditions, climate, or politics. It would become possible to learn when, where, and

how to apply automation and speed-up fact-gathering. The end products would be a much clearer knowledge of the cut-off value for widely-differing orebodies, a striking consequential increase in the world's reserves, and an attractive opportunity for young men considering what is today one of the most attractive fields of enterprise, a profession which combines travel, scientific application, and job interest.

E. J. P.

(17) *Water.*

Consumption in the Copper Industry

Some figures given to the U.S. Geological Survey in a report by O. D. Mussey show that on the average it takes more water to produce a ton of copper than of any other major metal. Some 330,000,000 gallons are used daily in the mining and manufacturing of primary copper in America, representing 0·3% of the total industrial use. Most of this is consumed in Arizona, Nevada, New Mexico, and Utah where the great bulk of the copper is mined and concentrated, much of the balance being used in the electrolytic refineries near New York city. About 100,000 gallons are used per ton of copper produced from U.S. domestic ores, 70% of this being consumed in mining and milling, the balance in refining the concentrates. Some 60,000,000 gallons (18%) are used daily in areas where water is scarce, this rate of consumption being about half the average, while 75% of the water is from surface and 25% from the ground, of which 89% is self-supplied by the copper producers and 11% by public sources of supply. Of the water thus used 46% is saline, with 1,000 parts per million of dissolved solids, and 54% is fresh.

(18) *Pumping.*

An Abrasion-Resistant Design

A centrifugal pump with exceptionally good wear resistance to abrasive slurries and sludges is described in a recent trade journal.[1] In it the important design feature is the location of a recessed impeller against one wall of the pump chamber in such a way as to create a vortex by means of which both suction and delivery take place. Since this impeller is clear of the main flow path very little of the passing pulp comes into direct contact, the risk of abrasion being correspondingly reduced. For non-abrasive material these pumps are made in spheroidal graphite iron but where pulps are handled Ni-hard is specified. One British company reports the successful handling of an unusually abrasive slurry where other types tried on this material, which was up to ½ in. cube, had failed. " Ni-Hard " is the trade name of a series of white chilled cast irons alloyed with nickel and chromium with a carbon range between 3% and 5%.

[1] *Inco-Mond Magazine*, No. 17

(19) *Chemical Extraction.*

Ion-Exchange Belts

A new British development in ion exchange offers the resins in the form of a continuous belt. This in suitable cases should simplify the continuous operations of stripping, washing, and elution of the seized ions. There is nothing new in the process, but the method of presenting the resins is novel. The resin is first suspended in a suitable solution and is then caused to coat on open-mesh cotton, rayon, or other gauze. The carrier liquid is then evaporated and the belt lightly pressed to remove irregularities.

Letter to the Editor

A Refractory Gold Ore

SIR,—The MAGAZINE for October, 1961, contains the first part of a review of my paper " Recent Progress in Milling and Gold Extraction at Giant Yellowknife Gold Mines Limited." There is one notable error in this review, and some misinterpretation which should be cleared up.

The reviewer states that the second two-stage fluid bed roaster at Giant Yellowknife was designed to handle 1,000 tons of flotation concentrate per day. This is quite wrong. The roaster was designed to handle the flotation concentrate produced from a milling operation of 1,000 tons per day. Ratio of concentration in the flotation circuit is approximately 5·5 to 1, and the capacity of the roaster is approximately 190 dry tons of concentrate per day.

He also refers to the installation of unit flotation cells between the secondary ball-mills and classifiers. Figs. 6 and 7 in my paper show quite clearly that the unit cells are

installed in the primary grinding circuit, to produce as coarse a concentrate as possible. He then states that with the unit cells in operation, the roaster feed contained 55% *minus* 325-mesh material which carries 70·7% of the gold. In the paper these figures were quoted to illustrate the condition we were trying to correct by installing the unit cells. That particular concentrate was produced before unit cells were installed, at a time when the liners in both primary mills were comparatively new, and very little ball slippage was occurring; a condition conducive to the production of granular concentrate. Six months later, after both unit cells were installed and operating smoothly, typical concentrates contained only 44% *minus* 325-mesh material carrying only 60·9% of the gold. This is a distinct improvement and was obtained under conditions much less conducive to production of granular concentrates—*i.e.*, the ball-mill liners were about three-quarters worn and pronounced ball slippage was occurring. Later on, with new ball-mill liners it was possible to reduce the *minus* 325-mesh distribution still further. The object of all this was, of course, to keep as much of the gold as possible in the coarser fractions of the roaster feed. Overgrinding of the valuable gold-bearing sulphides inevitably resulted in higher dust losses and inferior extraction in cyanidation. We were trying to retain as much mineral as possible in the roaster beds, minimizing the carryover to cyclones and Cottrells.

In the reviewer's version of the grinding and flotation flow-sheet, he shows sand and slime scavenger concentrates being returned to the roughers. At the time when the paper was written these products were sent directly to the roaster. Later they were cleaned in the cleaning circuit shown in my Fig. 7.

It is not my intention to criticize the reviewer. My own presentation of data is probably at fault. However, I would be grateful if you would publish this letter for the benefit of any of your readers who may have lived with similar problems and who may wonder at some of the statements in your review.

R. J. C. TAIT, P. Eng., M.C.I.M.

MANAGER,

LAKEFIELD RESEARCH OF CANADA, LTD.

November 3, 1961.

Book Review

In the Khirgiz Steppes. By J. W. WARDELL. Cloth, octavo, 190 pages, illustrated. Price 25s. London: The Galley Press.

Regarding this book of reminiscences a circular distributed by the publishers was headed "A book of interest to mining engineers," but mining engineers will find it disappointing. Considering that the Uspenssky mine was one of the specimen copper mines in the world, situated over 500 miles from railhead at Petropavlovsk on the Trans-Siberian Railway and 200 miles south of Akmolinsk, the nearest town of importance, the author might have given his readers more technical information on the functioning of the enterprise. No mention is made of the administration responsible for the dividends averaging 19% for the years 1909 to 1915, a period when Mr. E. T. McCarthy was consultant and Mr. H. C. Woolmer general manager. The organization controlling transport might have had more mention also. Apart from spare parts for the varied mechanical plants, timber for mining operations, coal from the colliery, ore to the smelter, and copper to railhead, there were foodstuffs of all kinds, clothing, and other items purchasable in the company's stores.

Conditions on the roads in summer and winter, with the hazards of swollen rivers, in the spring thaw and the blizzards of the winter are well described. On p. 73 the author states that the Russians (presumably the Ryanasov group) sank four shafts—the Vladimirsky, West, Magazine, and Sacred Hill. The West and Sacred Hill were small prospect shafts sunk by the reviewer on the S.W. and N.E. extremities of the ore-shoot, as recommended by Mr. J. N. Mackintosh Bell in his geological report on the Spassky copper mine, as part of the programme of sinking and diamond drilling to test for the continuation of the copper-bearing lode. On p. 74 it is mentioned that the Ryasanov group mined the rich zones of chalcocite and bornite between the 350-ft. and 430-ft. levels. The history of the mine is that, upon exhausting the rich oxidized and encountering an impoverished zone in the sulphides, the Ryasanovs sold out their interest to the Carnot group of Paris, the Spassky Copper mine being registered in July 9, 1904, in London. On p. 75 the author says that from 1909 to 1914 approximately 149,000 tons of ore averaging 19% copper was sent to the

smelter. This ore was chalcocite, mixed with bornite and chalcopyrite, disproving the statement that the Russians had mined that particular ore. Bell has recorded[1] that " the richness of the ore was phenomenal. Between the 350-ft. and 420-ft. levels there was a well-defined band of almost pure chalcocite along a soft hanging-wall, so rich that it had to be mixed with lower-grade ore for smelting, being richer than the matte desired in the smelting process. The rich oreshoots of the Annensky and Vladimirsky sections were found where the hanging-wall slate was highly shattered and wherever it contained a relatively high carbon content. Barite was more conspicuous in the richer ore than quartz and other gangue. The lode material was deposited in a zone of shearing in which extensive faulting had taken place by ascending solutions that apparently belonged to several generations and extended over a considerable margin of time. Later changes in the lode with attendant shifting of the copper content were made by descending solutions."

One would have expected to find more technical information on the operation of the Sara-su flotation plant in the book, as the author was connected with its design and erection and later held a responsible position in its operation. The description of the plant has three paragraphs only. At Karagandy the coal reserves were estimated at 400,000,000 tons. Today the Russians have developed it into a large producer with modern equipment and planned a city with large buildings in the latest architectural style.

The book is clearly written and will be of interest to two classes of readers—old employees of Spassky Copper Mine, Ltd., including associates of the author at Head Wrightson, and others will be those with an interest in the history of the 1917 Revolution. The maps are good, as one would expect from the author, and the book is well illustrated with a selection of photographs showing some features of Spassky, the Kirghiz, and the Steppe country.

There are 11 chapters, the first describing the journey the author made from England to Spassky and the last, his return home under revolutionary and aftermath of war conditions. The geographical description of Kazakstan and the Steppes is interesting reading, but it is a pity that more detail was not included. The chapter describing the life and habits of the Kirghiz brings many memories to the reviewer, who prior to the outbreak of war in 1914, spent the summer months prospecting and living among the Kirghiz and sleeping in their yurtas. There, one was generally the guest of the Head of the Aoul and on turning in for the night witnessed the old man having his back scratched by a servant and the seams of his cotton underclothes searched for lice ; the night could be sleepless. They had little use for the Russians. An episode, not mentioned by the author, occurred in 1915, when the Russian Military Authorities ordered the mobilization of young Kirghiz for military service. Being racially allied to the Turks they refused and, upon pressure being put upon them by the Cossacks, they commenced a scorched earth war against the Russian peasants, setting fire to crops and farmsteads between Spassky and Akmolinsk. During this outbreak the reviewer was sent to Petropavlovsk to obtain Prisoner of War personnel for Sara-su and the mine ; travelling at night it was an eerie sight seeing reflections of burning farmsteads. This rising was very quickly put down by a large troop of Cossacks with great cruelty.

The author does not mention that the reason for Mr. Morgan going to Peking *via* the Gobi desert was to escort to safety a small party of the British Military Mission that had become cut off on the retreat from the Urals and turned up at Spassky. One of that party, Major Phelps Hodges, wrote a book entitled *Britmis*, which gave Morgan a great deal of praise. It gave a very vivid account of the journey and the hazards encountered. The first chairman of the Spassky workmen's Committee was Mrs. Bayldon, wife of the manager. It was due to her able handling of the situation that no bloodshed happened when news of the over-throw of the Czarist regime and the revolution came through. At the mine, the reviewer's father-in-law, the late Mr. Charles Farmer, was held in such esteem by the workmen that there was no committee until after his resignation and return to New Zealand.

A little more could have been added to the account of the Czech rising at Petropavlovsk. According to the Brest-Litovsk Treaty the Russians were instructed to stop the Czech echelons going to Vladivostock for embarkation to France. About 200 Czech soldiers,

[1] Bell, J. Mackintosh. " Spassky and Atbassar Copper Mines." *Mining and Scientific Press*, May, 1920.

well armed and under Col. Jaque, were held up at Petropavlovsk Station, the Russians having confiscated their two locomotives. Jaque had been showing the Czech flag by very cleverly parading a number of small bodies of his men which gave the Russians the impression that there was a considerable number of troops. In the meantime Jaque informed the Bolshevik Commander that unless his locomotives were returned he would have to take them. This ultimatum made the Russians sandbag and mount machine guns on the roof of a four-storied meat factory overlooking the Railway Station. When the Russians had filled the factory with troops and refused to hand back the locomotives Col. Jaque struck and, with a handful of men armed with grenades, set fire to the building and blasted the troops out. As they fled across the 2 to 3 miles of wasteland to the town they were cut down by White Cossacks waiting for them. Most of the troops slaughtered and shot were Hungarian mercenaries, not Austrians, as stated by the author.

A last word; if Morgan safely conducted lost soldiers to safety across the Gobi desert, the author and his late wife safely conducted the reviewer's wife and two young children, one a baby, across Manchuria, Vladivostock, China, and by sea home to England, and for this the reviewer will be forever grateful.

R. ALLISON PURVIS.

☛ Copies of the books, etc., mentioned under the heading "Book Reviews" can be obtained through the Technical Bookshop of *The Mining Magazine*, 482 Salisbury House, London, E.C.2.

Engineering Log

In October the new Zelten oilfield of Libya started delivery by its 30-in. pipeline to Marsa al Brega. Libya's first exploratory well was drilled in 1956 and failed to strike oil. Since then over $1,000 million have been spent by 21 companies in developing the areas and of the 300 wells so far drilled oil has been struck in over one-third. Large quantities have been found in 11 areas right across from the Egyptian border to that of Tunisia, reserves being already of the order of 50,000 million barrels. By 1965 production should exceed 500,000 barrels daily or one-third of Saudi Arabia's current output. This is only a beginning, as Libya's deserts have as yet only been lightly prospected. Oil occurs at a depth of between 5,000 ft. and 6,000 ft. and the big pools are fairly near deep-water ports. A barrel of Libyan oil can be shipped to Britain at about half the equivalent cost from Arabia but what is even more attractive is that the Middle East can no longer hold Europe to ransom for its oil supplies. The potential stranglehold of the Suez Canal and such political factors are also lessened. Libya's search for oil has been costly. There are still millions of landmines and unexploded shells hidden in the sands and trucks must have armour-plated floors, while all the land used must be tediously cleared by mine detectors before it can be worked over. Temperatures in this part of the world may rise to 137° F. while the balloon tyres of trucks have a short life among the sharp rocks and desert sands. Some idea of the value of the oil discoveries can be had from the statistics for the Jebel Zelten well, south of Benghazi, the first to come into production for the Esso interests. It flows at 17,500 barrels a day and this, together with many other wells approaching a similar flow rate, has already justified the construction of a second pipeline nearer Tripoli for tapping the Dahra fields. Peak production is not expected for some years but already the impact of the vast new activity and its associated wealth is causing concern to the American companies who are aware both of the hostility of the "have-not" section of the native population and of the taint of political corruption.

* * *

Following a Continental lead the British Gas Council is now considering storage of gas in suitable underground geological formations which would be connected by a gas grid. The requirements are similar to those in which formation of a natural oil reservoir takes place. There must be a domed structure or an anticline in porous rock and this must be covered by an impervious clay and sealed below by permanent water. When gas is pumped in any water in the porous sandstone will be forced out. Britain now uses 600,000 million cu. ft. of gas annually, of which 43% is consumed in the summer and 57% in winter. The proposed scheme would overcome this out-of-balance problem of consumption by giving huge overall storage. Three possible locations are so far under consideration in the Midlands, one in Yorkshire, and a more promising one in Hampshire. This, at Chilcombe, near Winchester, would hold some 10,000 million cu. ft. of gas under

a pressure of 700 lb. to 800 lb. per sq. in. in the Greensands, which here are between 50 ft. and 75 ft. thick and 800 ft. down. They are overlaid by the Gault, a blue-grey clay.

* * *

Thin-layer chromatography promises to improve the sensitivity over the methods used in ordinary paper chromatography. Special grades of silica gel, aluminium oxide, and kieselguhr allow higher temperatures to be used while separation time is reduced and sensitivity increased considerably. The thin adsorption layers are produced by coating glass plates, which are dried at about 130° C. and are then ready for use.

* * *

A robot miner powered by car batteries has been built at Sheffield University. It is thought of as an automatic machine which could do routine jobs or work in an awkward place. It could load from automatic coal-cutting machinery in thin, hot, or gassy seams, for example, or it could be used to put out a fire in a smoke-laden atmosphere. Its outstanding feature is a simple programming electronic device. This is a black-and-white map which runs past photo-electric scanning equipment. Impulses are thus sent out which give time-and-distance information to the robot. This enables it to steer itself to designated points and there do its set work. It would probably cost under £1,000, it is believed, and might be useful in a wide variety of servicing jobs.

* * *

Exciting possibilities for insect pest control have been opened up by the success of two American entomolists, Drs. Knipling and Bushland, in their war on the screw-worm fly. Its larvae, which infest cattle, are chemical-resistant and losses have run into millions annually. Their method, proposed over 10 years back, seemed too visionary for practical use but persistence has now proved its worth. The idea is to make the flies breed themselves out of existence. Females mate only once whereas males are polygamous. Hence, if a female mates with a sterile male, that is that. Given an adequate supply of such males the fly population dies out. Sterilization can be effected by doses of gamma rays without otherwise affecting the male fly's activity and acceptability to his lady friends. First success came when Curacao was plagued in 1953. This pilot operation was followed by an 18-month campaign in Florida, where 50 million sterile males were distributed weekly by a fleet of 20 aeroplanes and at the end the screw-worm had been wiped out. Re-infestation could of course occur, but the immense advantage of the technique over those which use chemical sprays is that no resistant strains develop as has occurred with mosquitos subjected to D.D.T. Further the predators are untouched, though probably starved, and there is no risk of food poisoning or danger to beneficial wild life. The sterile-male technique is being studied in the hope that it, or a working variant, may be extended to other harmful species such as mosquitos and locusts.

* * *

The U.N. conference which met recently in Rome to discuss natural sources of energy broke new ground and clarified old ideas on the harnessing of sun, wind, and geothermal exploitation. Solar energy although widely available is hard to tap economically, but underground heat promises to be a cheap source of power where available. Wind, widely available, is between sun and underground sources in cost of harnessing. In hot countries the sun delivers 10,000 times the energy per sq. ft. that is consumed in a highly industrialized community, so that the many underdeveloped places in the low latitudes are starving for power supplies in the midst of plenty. One Israeli prototype solar-powered plant exhibited at the conference promises to be competitive with diesel sets where fuel is costly. It has a small turbine driven by monochlorobenzene, a heavy organic vapour which gives a marked improvement on steam for a small turbine, with an efficiency of the order of 15%. Heat is collected in sausage-shaped transparent balloons 4 ft. in diameter and 30 ft. long. Half the balloon is aluminized and collects sunlight which it focuses on black pipes running the length of the sausage. The system only needs re-orientation once a week and is simple to fabricate. It can produce from 2 kW to 5 kW of electricity at 2d. to 3d. per hour while the sun shines and a heat storage unit is feasible for night use. Another Israeli project, still in an early stage of development, is the " solar pond." This, from 3 ft. to 6 ft. deep, has a black bottom and a lower layer made dense by dissolved salts which suppress convection. Heat therefore accumulates below while the upper layer acts as an insulator to prevent re-radiation of the heat entering the pond. So far a bottom temperature of over 90° C. has been achieved. This type of heat store might compete with cheap electricity on a

larger scale and would be more continuous in its running once the main problems—extraction of the heat without disturbing the water layers and prevention of mixing these when the wind blows—have been solved. Turning to geothermal sources, it was noticed that Iceland now has 45,000 people, 80 swimming pools, and 100,000 sq. metres of greenhouse enjoying this development. The conditions which produce geothermal areas are still not fully understood. The old picture of a large mass of porous underground rock near volcanic heat, with a non-porous capping—all so arranged that percolating rainwater is trapped—does not explain hot springs found where these conditions do not obtain. One point repeatedly made by representatives of underdeveloped countries was the tendency to make assumptions based on conditions in more advanced countries. In a remote rural area, for example, it would not matter seriously if solar power was only on tap by day as there is little need for it by night.

News Letters

BRITISH COLUMBIA

November 7.

Crown Lands.—The Hon. W. K. Kiernan, Minister of Mines and Petroleum Resources for British Columbia, has announced a huge sale of Crown Reserve lands in the north-eastern part of the Province to take place in Victoria on November 16. Especial attention is assured on this occasion due to the unprecedented rate of discovery during the past year.

Portland Canal.—Granduc Mines is calling for tenders to drive a 12,000-ft. large-dimension tunnel from surface at the company's airport site to connect with the lower level of the mine 25 miles north-west of Stewart. In recent work six ore-grade intersections and several others of marginal worth were obtained beyond the ends of the proved 4,600-ft. length of the ore zone. The known length of favourable structure has been increased.

Vancouver Island.—New Privateer Mine is driving a second and deeper series of diamond-drill holes at its Uebell group of claims adjoining the Privateer mine at Zeballos. In first drilling 13 holes provided indication of 100,000 tons of ore over a surface length of 240 ft. and vertical interval of 175 ft. in the " A " zone and length of 160 ft. and depth of 200 ft. in the " B " zone; average grade was 2·19% Cu in the " A " and 2·10% in the " B " zone. The deeper " bite " of the new series is projected with a view to doubling the indicated reserve. No further work is to be done on rehabilitating the lowest levels of the Privateer mine or in seeking gold-ore extension to greater depth.

Copper Town Mines has reported a shipment of 288 sacks, estimated at 10 tons, of jig and flotation concentrate to the Tacoma smelter from the Musketeer mine, near Tofino. The company claims a grade of better than 1 oz. of gold per ton.

During the few weeks of bulk sampling this autumn Mt. Washington Copper shipped 1,200 tons of high-grade ore directly to the Tacoma smelter and 5,300 tons of run-of-the-mine material to the Britannia concentrator for custom treatment. So far the company has received reports only on the first 1,128 tons shipped to Britannia and this assayed 0·015 oz. of gold and 1·83 oz. of silver per ton, with 2·07% copper. Company officials are encouraged by the grade in view of the dilution attendant on the open-pit mining methods employed. Further mining has been discontinued because of weather conditions, but diamond drilling is in progress.

Powell River.—Anuwon Uranium Mines has purchased the Bonanza group of 20 mineral claims on Goat Island, in Powell Lake. Old reports of the B.C. Minister of Mines record shipments assaying from 8% to 11% copper. Two adits were driven and an aerial ropeway constructed in the former operation. Mr. A. R. Allen, the consulting geological engineer, has found impressive showings on the hillside and reports the presence of numerous stringers, veins, and lenses in close proximity. Samples from ore in place taken by the consultant have assayed 4·9% and 4·15% and a character sample from the dump 6·25% copper. Former workings are to be rehabilitated and a diamond-drilling programme undertaken at once. Anuwon has entered into an option agreement with Merritt Mining Explorations, Ltd., whereby the latter will finance the development and provide the necessary mining equipment.

Bridge River.—The production of Bralorne Pioneer Mines for the third quarter of 1961 was 27,611 oz. of gold, valued at $966,385 ($35 per oz.), from 38,274 tons of ore assaying 0·72 oz. of gold per ton. Construction of the cyanide circuit was completed at the end of June and was successfully " broken in " during the third quarter. Basic renovation of the grinding circuit is underway and scheduled for completion in November. Renovation of the less critical

crushing department will proceed through the winter. The 4-level drift on the 51-B foot-wall vein has developed a block of probable ore now being made ready for production. Drifting has commenced on the 107 vein on the 20 level where high values have been found over narrow widths. The 38-level drift on the 77 vein extended the ore-shoot to 560 ft. averaging 0·51 oz. of gold per ton over 6·5 ft. in width. A westerly extension of the shoot has been indicated but further drifting has been deferred to facilitate development on the 37 level. Two diamond drills are at present being operated in the Bralorne mine on exploration.

On the Ace option project, in the lower Bridge River valley, Bralorne Pioneer has traced the Bluff vein on surface by trenches over a length of 825 ft., over which length an average width of 3·5 ft. grades 0·13 oz. of gold and 1·6 oz. of silver per ton with 3·03% antimony. The attitude of this vein suggests an extension of one of the original veins in the Congress mine. In the first hole driven to test this theory an intersection of 24 ft. grading 0·22 oz. of gold per ton was obtained.

Merritt.—Cardiff Leasing, Ltd., of Calgary, is to lease mining equipment valued at $30,000 to Quilchena Mining and Development for use in the exploration and development of the Quilchena gold property, near Merritt. The claims were formerly held by Guichon Mine which will receive 40% of the net profit from production.

Kamloops.—Galaxy Minerals is to continue its diamond-drilling programme throughout the winter as a result of the very encouraging results of the work done this summer and since. The work has consisted of geochemical, magnetometer, induced polarization, and surface geological surveys as well as diamond drilling, all under the direction of Dr. P. C. Badgley, the consulting geological engineer. Chalcopyrite mineralization of open-pit grade (0·5% to 2·0% Cu) has been revealed over a length of 1,200 ft., width of 100 ft. to 250 ft., and depth of 300 ft. Dr. Badgley states :

"Currently available information suggests that the Galaxy orebody might be extended over several thousand feet of length and to considerably greater depths as it occurs in the north-east wallrock of a very strong shear zone. The wallrock is a strongly crushed older diorite which has been intruded by a younger strongly altered diorite porphyry. Both older diorite and porphyry are mineralized. The shear zone is over 100 ft. wide and shearing is extremely intense. Both shear zone and wall rock are known to persist along strike for some distance. Thus, the Galaxy orebody could well extend over several thousand feet of length. Chalcopyrite mineralization in the Kamloops district is already known to extend well over 1,000 ft. of vertical range, so that the depth of the Galaxy orebody is by no means limited to 300 ft., to which the current drilling programme has extended."

Kamloops Copper had reduced the water level in the Iron Mask mine to within 150 ft. of the lowest working at the end of October. Reclamation of some of the higher levels is now in progress and the Erin shaft is being retimbered. The company has purchased the assay plant of Mastodon-Highland Bell. Mr. H. L. Hill, the consulting engineer, told the annual meeting that old reports indicate a cut-off grade of 3% copper was employed in stopes 30 ft. wide in earlier operations. He said such a practice could have left a lot of material of current ore grade.

The annual meeting of Friday Mines on October 27 heard encouraging progress reports of geological and geophysical exploration from Mr. J. A. Wood of the consulting firm of Chapman, Wood, and Griswold, of Vancouver, and from Dr. R. A. Bell, of McPhar Geophysics, Toronto. It is believed the Nicola series, a competent host rock, has been oriented on the property. An induced polarization survey has been conducted under the direction of Dr. Bell. Two deep test holes are being put in to explore the ore-making qualities of an indicated anomaly. The narrow high-grade vein system of the former Hedley Monarch mine has responded most favourably to the work done to date.

Granby Mining Co.—Granby Mining reports gross mining and other income of $575,522 for the third quarter of 1961, bringing the aggregate to September 30 to $1,526,738. Total production expense was $365,289 and administration and other expense $63,397, thereby leaving a net operating profit of $146,836. Mr. L. T. Postle, the company president, confirms expansion of the concentrator of the wholly-owned subsidiary, Phoenix Copper Co., to 1,500 tons daily with the additional capacity to be available during the second quarter of 1962. A larger shovel has been purchased to speed waste removal from the Phoenix orebodies. Good progress is reported by another subsidiary, Jedway Iron Ore, in the preparation of its iron property on Moresby Island for production by mid-1962.

Company News.—Ruby Silver Mines has been incorporated with capital of 4,500,000 shares (50 cents par value) to acquire title to 26½ claims and fractions on Wallace Mountain

adjoining the Highland-Bell mine. Sheritt-Lee Mines has received 1,200,000 shares of Ruby Silver in consideration of 6½ claims and the expenditure of some $120,000 in development during the past 2½ years, while Silver Bounty Mines was issued 1,100,000 shares in consideration of title to the other 20 claims and to the surrender of the right to collect $200,000 in a percentage of net smelter returns from Sheritt-Lee. Sheritt-Lee Mines will continue to pursue and finance the development of the silver prospect and will take down up to 450,000 additional shares of Ruby Silver in payment therefor. Sheritt-Lee has recently purchased the 150-ton mill formerly owned by Vancouver Island Base Metals, Ltd., successor to Twin " J " Mines, Ltd.

From commencement in August, 1960, to the end of September, 1961, McKinney Gold Mines shipped 6,800 tons of siliceous ore to the Trail smelter. A 45° rise has encountered a new ore-shoot 200 ft. further east than any previous body. The new shoot at last report assayed 1·9 oz. of gold per ton over an average width of 1·3 ft. to a height of 47 ft.

Amcana Gold Mines has suspended work on its 16-claim gold prospect 24 miles north of Westbridge for the winter. Geophysical surveying indicated 13 anomalies on the property and this was followed by extensive bulldozer stripping and trenching. An important zone of mineralization was found to extend across the Hackla and Barnato claims. Mr. A. R. Allen, the consulting geological engineer, states this extensive zone comprises an excellent prospecting possibility. The veins are narrow but numerous and with gold-bearing sulphides contained therein. A permanent camp will be established when work resumes next spring.

Dorreen Mines staked a gold prospect of 16 claims in the Camp McKinney area during the year ended April 30, 1961. The company has working capital of only a little more than $1,000, but with only 1,242,784 shares of its authorized capital of 3,000,000 shares issued is in a favourable position to finance preliminary exploration.

Underground sampling by Prudential Petroleums, Ltd., on the Tam O'Shanter Crown-granted mineral claim, adjoining the Bluebell mine on the east shore of Kootenay Lake, has revealed good lead-zinc-silver values. Prudential has let a contract for 3,000 ft. of diamond drilling.

Bon Ton Silver Mines has secured an option to purchase the R. E. Adams Crown-granted claim and five adjoining claims on Stenson Creek, four miles south of Retallack. The property was opened extensively several years ago. Bon Ton has reclaimed and rehabilitated the No. 4 tunnel and commenced sampling.

Silver Standard Mines drilled a total length of 2,572 ft. in nine diamond-drill holes since acquiring its option on a 59-claim prospect one mile south-west of Sandon last summer from Oil Participations, Inc. The work fulfills the obligation to expend a minimum of $25,000 during the first year of the option and gives Silver Standard the right to carry on with a commitment of $100,000 over the next four years.

Continental Consolidated Mines has obtained an option to purchase three placer leases in California Gulch, six miles south-west of Barkerville. The company had evidence that two men had recovered 15·8 oz. of gold within three hours in an hydraulic operation.

Fort Reliance Minerals has completed a geophysical and geochemical survey on its Omineca copper prospect in central British Columbia. Several anomalies were outlined and a new surface exposure of copper found. Additional ground has been staked adjoining the original claims.

Sales of the Cassiar Asbestos Corporation increased by 13% in the year ended September 30, 1961, and operating profit rose to $5,759,710.

Yukon.—Conwest Exploration will bear 80% of the $400,000 cost of an exploration programme on a silver-lead prospect at the headwaters of the Liard River, 100 miles north of the Alaska Highway. The property was discovered on July 31, 1961, by Mr. Nels Hals, a prospector employed by Conwest, and when samples from veins exposed in place and from float in the vicinity were found to contain high silver values 296 claims were staked. Nine veins have been exposed in a cirque between 5,300 ft. and 5,600 ft. elevation. Work to date has not determined the full length of any of the veins and the longest exposure, 200 feet on the No. 8 vein, is open at both ends. In addition to the showings in the cirque five additional exposures and several areas of mineralized float have been found extending to the north-west between elevations 4,600 and 5,300 ft. for a distance of 4,300 ft. Samples indicate high silver and lead values. Mr. W. P. Hammond, manager of Conwest's exploration and development department, rates the discovery highly and states it warrants a major development programme which will include : Construction of a winter road from the Alaska Highway near Teslin, a distance of approximately 100 miles ; delivery and assembling a mining plant, with equipment

and supplies to be on the ground early in 1962 when road conditions permit; underground exploration to be commenced by March, 1962, by driving an adit to explore two or three of the known veins, and a programme of surface prospecting and development throughout the 1962 season. Central Patricia Gold Mines is to provide the remaining 20% of the budget. Application has been made for Federal Government assistance in the construction of the winter truck trail.

Peso Silver Mines has uncovered a length of 3,900 ft. of silver-bearing veins in five separate areas on its 100-claim property 15 miles west of the United Keno Hill mine.

New Imperial Mines has received a firm underwriting in the amount of $225,000 for the development of its Whitehorse Copper Belt property. The agreement calls for expenditure of $75,000 in the first year and $150,000 in the next. New Imperial will receive a 30% interest in a new company to be formed in the event of production.

EASTERN CANADA

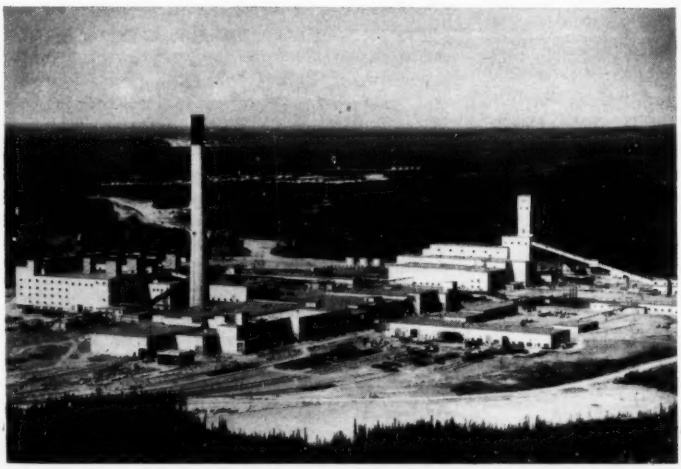
November 20.

Ontario Gold Production.—During August the gold mines of Ontario milled 706,283 tons of ore and produced 196,926 oz. of gold and 28,900 oz. of silver, valued at $7,200,769. In September the 683,267 tons treated yielded 186,170 oz. of gold and 29,633 oz. of silver, worth $6,744,240. According to the *Gold Bulletin* of the Provincial Department of Mines, 30 producing gold mines reported milling 6,773,054 tons of ore in the first nine months of 1961. This yielded 1,931,072 oz. of gold and 285,214 oz. of silver, with a total value of $68,306,259. Carium Mines, Ltd., completed operations during July, 1961, and Sylvanite Gold Mines, Ltd., finished work during August. In the corresponding period a year ago, 31 mines reported milling 6,964,249 tons of ore, yielding 1,978,796 oz. of gold and 326,733 oz. of silver valued at $67,253,872.

Sudbury.—The interim report of the International Nickel Co. of Canada and its subsidiaries for the nine months ended September 30, 1961, shows net earnings in terms of U.S. currency of $58,232,000 after all charges, depreciation, depletion, taxes, etc. For the first nine months of 1960 net earnings were $62,685,000, or $2·14 per share.

Falconbridge Nickel Mines reports an operating profit of $11,448,708 for the first six months of the current year, which compares with $10,735,709 for the corresponding period of 1960.

Uranium.—Rio Algom Mines reports a net revenue of $55,217,000 for the nine months to September 30 last and a net profit of $10,052,000 The report for the period points out that at the start of 1960 there were six uranium mines in operation against three at the beginning of 1961. Production since June 30 last has come from the Milliken and Nordic mines. At a special meeting on October 27 the shareholders of Rio Algom approved the purchase of certain assets from the Rio Tinto Mining Co. of Canada for $7,066,000.



Ball-Mills at the Thompson plant, Manitoba.

In noting a loss of $918,000 for the nine months to September 30 last Preston Mines reports that this resulted from the shut-down costs of the Stanleigh mine, while the cost of servicing the company's long-term debt was anticipated. It has now been offset by a credit to retained earnings at August 31, 1960, arising from the sale of a part of the Stanleigh-Eldorado contract.

Rio Tinto Mining Co. of Canada.—Last month the Rio Tinto Co. announced that an offer had been made by its Canadian subsidiary, Tinto Holdings, Ltd, to purchase shares of the Rio Tinto Mining Co. of Canada, Ltd., at 95 cents (Canadian). It was also announced that the recent shareholders' meetings of Rio Tinto Canada and Rio Algom Mines had approved the purchase by Rio Algom of a substantial portion of the assets of Rio Tinto Canada.

Cobalt.—Shareholders of Rix Athabasca Uranium Mines have been informed in the report for the September quarter that development to gain access to the silver vein structure on the United Cobalt property previously indicated has been in progress and that shaft sinking and station cutting were completed at the end of the quarter and the shafts made ready for use. Extension of the two planned crosscuts is to comprise the work over the next several months. Expenditures on the United Cobalt project totalled $227,000 to the end of the quarter and the balance of the programme, including raising and drifting, is expected to carry into the second quarter of 1962.

It has been announced that Cobalt Refinery, Ltd., has bought the plant formerly worked by Quebec Metallurgical Industries, Ltd., and has commenced customs work for local producers. Formerly this works produced metallic silver and a speiss.

Quebec.—Dredging operations, it is now reported, have been started by the Beauce Placer Mining Co. at its properties 50 miles south-east of Quebec. A year ago the company purchased an 800-ton dredge and brought it across the continent from Idaho. It is calculated that each yard of gravel in the reserves along the Gilbert River contains about 22 cents worth of gold and 6,000 cu. yd. will be handled daily.

Gaspe Copper Mines is in process of erecting a pilot plant with a view to producing molybdenite concentrates. It is reported that the presence of molybdenum in the ore has been known for many years.

AUSTRALIA

November 20.

Mineral Exports.—The Minister for National Development has reported Australia's mineral exports in 1960 to have reached a value of £A90,000,000. In the forefront of export values were gold £16,300,000, uranium £11,000,000, lead, £20,300,000, copper £15,500,000, zinc, £4,000,000, coal, £6,500,000, rutile £4,100,000, iron and steel £2,600,000, silver, £1,100,000, and opal £1,000,000. Mount Morgan, Ltd., has started the export of blister copper, a shipment of 1,000 tons having been made recently to Europe. This move follows the serious drop in Australian consumption of copper and the new departure in sales will enable the company to take advantage of certain rebate applications in the Commonwealth Government's taxation provisions in regard to exports. Notable amongst exports is the high total value of opal to leave Australia.

Coal is looked to for export expansion and substantial overseas orders are being placed, the Japanese market being particularly active. Orders held by Australian collieries are stated to represent £A27,000,000 over the next five years. This business is mainly with New South Wales producers, but useful orders have gone to Queensland. One company has secured orders amounting to £10,000,000 over a five-year period. This coal will be supplied from the Kianga-Moura field, and Mount Morgan, Ltd., is studying the prospects of overseas trade from its Barababa collieries. An important factor in this trade continues to be the improvement in ports and their loading facilities.

Following recent orders to Queensland, the Commonwealth Government has offered financial assistance for the improvement of facilities at Gladstone, the port of shipment for the Dawson Valley field, covering deepening and provision of larger-capacity coal-loading plant, to meet the export of 1,000,000 tons per year. The New South Wales State Government, with the assistance of the Commonwealth Government, has authorized the expenditure of £10,000,000 for improvements at the harbours of Sydney, Newcastle, and Port Kembla.

Gas in New Zealand.—There is much interest in the discovery of natural gas by Shell, B.P., and Todd Oil Services in their drilling operations at Kapuni, near New Plymouth, in the North Island of New Zealand. There are good grounds for the expectation that the production from Kapuni No. 2 bore, when fully developed, will be about 100,000,000 cu. ft. per day. The bore is well placed in relation to the cities of Auckland

and Wellington and is 50 miles from New Plymouth.

Broken Hill.—Broken Hill South has become a centre of interest because of entry into the aluminium field in the Alcoa of Australia project. The South mine itself is working a contracting orebody, but reserves have diminished slowly and have now receded to 1,130,000 tons. For three years or so there have been sound hopes that exploratory work in the structure to the west of the Broken Hill lode would locate a commercial orebody, to which end indications have been favourable. The latest development in the South position is the purchase by that company of the Junction–British leases of the North mine. The sale of the leases is subject to the approval of the New South Wales Department of Mines. It is considered that the extension of life resulting from the acquisition of this new ore will maintain South Mine operations until the Cobar project can be developed and through the early stages of the aluminium enterprise.

North Broken Hill has stated that the mine will not be affected by the tonnage of ore transferred to Broken Hill South. Proved ore reserves in the North section approximate 4,200,000 tons and diamond drilling has shown probable ore amounting to about 6,000,000 tons. The lode continues strongly beyond the limits containing these tonnages. The company will maintain its output of ore after transfer of the British–Junction section by drawing from the No. 2 shaft in the North section a tonnage equivalent to that hitherto mined from the section sold. Progress in the sinking of No. 3 shaft has been relatively slow and expensive, because of the stressed condition of the ground, but the rate was improved during the period. It is expected that sinking to a depth of 4,320 ft., which will be 50 ft. below No. 31 level, will be completed during the current financial year and that cage operations would be possible by June, 1962. The company is continuing prospecting for tin, copper, and molybdenum in North Queensland and exploration for copper in the Moonta locality, South Australia. Prospecting is also in progress in the Broken Hill district beyond the leases of the North Mine itself.

Oil Exploration.—The Commonwealth Government is fully aware of the need for its active participation in the search for oil in Australia and of assistance and encouragement to the exploration companies engaged in the work. Recent approved applications for assistance by means of subsidy total £A148,872, covering stratigraphic drilling, seismic survey, and aeromagnetic survey in Queensland, Victoria, and South Australia. In this financial year the Commonwealth will spend a total of £A4,100,000 in oil search, made up of £A1,400,000 on investigations and mapping and £A2,700,000 in subsidies to exploration companies.

Titanium in Western Australia.—Developments favouring the establishment of an important chemical industry in Western Australia may follow the expected ratification by the State Parliament of a 50-year agreement with Laporte Industries for a £A4,000,000 titanium oxide industry to be established at Bunbury, in the south-west of the State. The factory, as planned, would produce 10,000 tons of titanium oxide pigments per year, together with sulphuric acid. A provision has been inserted in the agreement that, if during construction, the company found that because of altered circumstances, or other developments, it required financial aid, the Government would try to arrange assistance, up to one-third the total cost, or £A1,300,000, whichever was the lesser. There are large deposits of ilmenite on the Western Australian coast south of Fremantle centred mainly near Bunbury.

Gold Mining.—The Chamber of Mines of Western Australia is pressing for recognition by the Commonwealth Government of the importance of an increase in the production of gold as a source of export income. The Chamber also considers that the assistance given under the Gold Mining Assistance Act is too narrow and is pressing vigorously at every opportunity for an increase in the price of gold. The Chamber holds the view that a section of the Gold Mining Assistance Act discriminates against the older established mines by limiting the amount of assistance in accordance with an outmoded capital structure. It suggests that a development allowance should be given those mines not eligible for assistance under the Act. The allowance should be made at 4s. per ton of ore treated for extra development expenditure above a base year or years to be determined. The estimated cost of such an allowance would be about £A500,000 per year.

A subsidy on a £ for £ basis has also been requested for diamond drilling, as distinct from normal development diamond drilling as defined in the Act, while Government loans are requested to bring selected properties into production or for approved capital work.

Iron Ore.—It has been reported on good authority that a large deposit of iron ore in the north-west of Western Australia has been discovered. The occurrence was located from

the air and confirmation of tonnage and grade must be established by surface examination. The ore is reported as limonite and a preliminary report puts tonnage at some 1,800,000,000 tons. The locality is a very extensive mineralized zone and confirmation, in whole or in part, could be of much importance to the State of Western Australia and the expansion of the iron and steel industry.

FAR EAST

November 17.

Malayan Tin Industry.—Following a recent meeting of the council of the F.M.S. Chamber of Mines in Ipoh, Mr. K. J. Cumming, who presided, said that the producers had unanimously proposed at the London meeting that the floor price be increased from £730 to £800 a ton and the ceiling price from £880 to £1,000, "a reasonable price range which could be fully justified in view of the need to stimulate production to close the gap between supply and demand and thus meet consumers' requirements. . . . Delay in establishing a price range to do this results in uncertainties and lack of confidence."

The All-Malaya Chinese Mining Association has also expressed "bitter disappointment" at the failure of the International Tin Council to establish a new price range. Mr. Lau Pak Khuan, acting president of the Association, said his committee was "gravely concerned" at the failure of the I.T.C. to arrange a new price as most of the mines that have been recently re-opened after being shut down for years, or new mines started up for the first time, are operating on marginal ground. The committee had also decided, said Mr. Lau, to make representations to ensure that U.S. stockpile tin that may be unloaded on the market in the future should not be sold at a price lower than £1,000 a ton.

The offer to the Malayan public to buy 4,500,000 ordinary shares of (Malayan) $1 each of Eastern Smelting Co., Ltd., at $2.25 per share, referred to a month ago, has been reported to have been heavily oversubscribed. The headquarters of the Eastern Smelting Company was recently transferred from London to Penang and Mr. F. J. Steggall, the managing director, in discussing the prospects of the company, said that for many years the concentrates available for smelting in Malaya had been treated by two large smelting plants—that belonging to the company and that belonging to the Straits Trading Co., Ltd., with whom the company enjoyed amicable and harmonious relations. As a result of a decision of the Indonesian Government part of the concentrates from Indonesia were shipped to the Federation of Malaya during 1960. The company received a share of these concentrates for treatment and arrangements had been made for the shipment of further quantities of Indonesian concentrates for treatment in Malaya during the period of three years ending April 30, 1964. He said that the directors were aware of the Indonesian Government's public announcement of future plans for the erection of a smelter on Banka island, of proposals made for the erection of a tin-smelting plant in Thailand, and of a proposal by Japanese interests to erect a small plant in Malaya. During recent years, he said, such proposals had been put forward from time to time but had not so far materialized and it was difficult to assess whether the present proposals would mature.

Malaya's tin production for the first nine months of 1961 totalled 41,457 tons—3,362 tons more than the output for the corresponding period of 1960 and 3,932 tons more than that for the whole of 1959. At the end of this September there were 678 active tin mines (an increase of 15 over the August total), the mines in operation comprising 69 dredges, 558 gravel-pump mines, and 51 others. At the end of September last 31,463 persons were employed in tin mining (an increase of 41 over the August total).

Joint Ventures.—A cement works now being built at the Singapore Harbour Board's West Wharf is due to start production next April. It is a joint venture between the Hong Leong Co., Ltd., of Singapore, and two Japanese concerns—Onoda Cement Co., Ltd., and Mitsui and Co., Ltd. It is understood that capital of (Malayan) $6,000,000 has been equally subscribed by the three companies. The plant is planned to produce 180,000 tons of cement a year, gradually increasing to a maximum of 240,000 tons.

A big joint Malayan-Japanese steel mill planned for the Federation of Malaya will probably be located in the Prai district of Province Wellesley. The plant, which is expected eventually to use power from the Cameron Highlands hydro-electric station, will be built in two stages. The first is planned to be ready early in 1964 and the second early in 1965. Estimated production for the first stage is 120,000 tons of sponge iron and 60,000 tons of bars a year.

SOUTHERN AFRICA

November 29.

Industrial Outlook.—At its recent convention in Johannesburg the Federated Chamber of Industries of South Africa decided to support the drive to create a more favourable image of South Africa abroad. A standing committee on publicity and propaganda was appointed to support the Ministry of Information (recently established), the South African Foundation, and the South African Tourist Corporation. It also decided to promote exports and a convention of exporters is to be held in Johannesburg next May. Higher wages for non-Whites were also discussed and a questionnaire will be drafted for industrialists in the near future. In the course of the convention the Minister of Economic Affairs, Dr. Diederichs, invited industrialist representatives to discuss with him and his Department the formulation of a five-year programme of expansion in the manufacturing industry on a composite basis, including action by both the Government and industry. The chairman of the Board of Trade and Industries, Dr. A. J. Norval, on the eve of his retirement, warned against neglect to make full use of the country's human resources and its economic resources, stressed the importance of export markets, pointed to the importance of greater purchasing power which could be created through expanded production and higher African wages, warned against the false pride of neo-mercantilism or economic nationalism which was rearing its head, stressed the need for careful research to determine lines where the country enjoyed distinct comparative advantages and to export therein, and to import where domestic production involved excessive cost behind high tariff walls and such restrictive measures as stringent import controls.

A committee has been appointed by the Government to investigate the tariff system of the South African Railways, specifically with reference to the promotion of the decentralization of industries and the development of industries on the borders of the Native Reserves, to rail and road transport of goods, and to harbour services.

Natural Resources.—A statutory committee, authorized by the Government, has been appointed by the Natural Development Resources Council to investigate various aspects of minerals, in so far as they affect the national economy from the point of view of reserves, production, domestic processing to varying degrees of finished products, etc. The programme will initially cover asbestos, chromite, copper, and manganese ore and extend later to include other minerals, their mining, processing, and marketing. Commenting on the announcement the Minister of Economic Affairs, Dr. Diederichs, stated that while there may be economic markets for the raw material there may be no apparent market for the processed or semi-finished product, but this should not be a deterrent from the establishment of new markets and the adjustment of the degree of processing to potential markets. The committee members so far appointed are: P. S. Rautenbach, Director of Planning of the Natural Development Resources Council, as chairman; T. L. Gibbs, Acting Government Mining Engineer; Dr. J. de Villiers, of the Geological Survey; Dr. R. E. Robinson, of the Government Metallurgical Laboratory; Dr. P. C. Carman, of the Council for Scientific and Industrial Research, and T. F. Muller, of Federale Mynbou Bpk. The Income Tax Act of 1961 granted a new capital amortization allowance of up to 100 per cent. to be written against profits, this percentage to be dependent on the degree of domestic processing.

Under the auspices of the Natural Resources Development Council a development programme is at present being prepared for the Pretoria-Witwatersrand-Vereeniging area. This area—embracing the largest gold-producing zone in the world—is also richly endowed with coal, diamonds, and other minerals, has about 6,000 of the country's 12,000 factories, and is populated by about 3,000,000 persons distributed over about 500 sq. miles. The development programme will take into account that over the next 10 to 20 years or so gold output will decline by about half or more.

Rockburst Research.—Epitomizing less the carrying of coals to Newcastle than the cliché that knowledge knows no boundaries is the announcement of the establishment of a special course (which seven South African mining graduates will attend) by the Department of Mining, University of Durham, on rockbursts and similar problems. The course includes visits to mines in the vicinity, to other universities, and to research establishments of the National Coal Board of the United Kingdom, as well as to mining research centres of Belgium, France, The Netherlands, and West Germany. The course was formulated following a recent visit at the invitation of the Transvaal and Orange Free State Chamber of Mines of Professor E. L. J. Potts, Professor of Mining Engineering at Durham University, to advise on rockburst research.

Gold Mines.—From the drive connecting No. 4

Shaft in the extreme north-eastern section of West Driefontein Gold Mining with workings extended eastwards from No. 3 Shaft to the west a cross-cut has been cut to the sub-outcrop zone of the Ventersdorp Contact Reef and sampling effected which disclosed payability over 895 ft. or 66·8% averaging 365 in.-dwt. This is of a lower tenor than the disclosures on the same horizon in the south-western section, where in 1960–61 payability was 82·8% averaging 549 in.-dwt. and the Ventersdorp Contact Reef ore reserve averaged 460 in.-dwt. Equipping the No. 4 Shaft has proceeded far enough to permit an early start of development towards the Ventersdorp horizon. In the south-western section the No. 5A Subvertical Shaft has been completed to its final depth below 8,000 ft. from surface, from which development is now in progress to open up the high-grade Carbon Leader Reef in the immediate future. Values should make Ventersdorp values look silly. A shareholder at the recent annual meeting suggested that perhaps the mine management was pushing things a bit too hard, that perhaps things could be spun out a little, but the chairman, without guile or sadistic intentions, answered that the tax-paying stage having been reached, additional revenue from an accelerated programme would be taxed on the same basis as at present, that while pumping capacity was more than adequate the water problem could become more difficult, that rising costs were a consideration, and that, in short, it was best to get the gold out as quickly as possible.

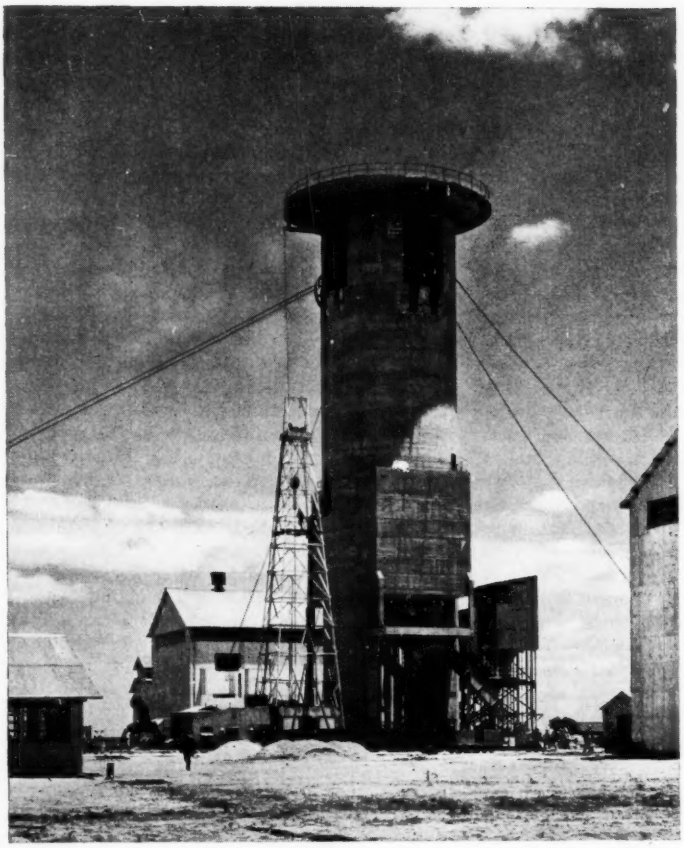
Eastern Transvaal Consolidated Mines has concluded a tributing agreement over, with the option to purchase, a dormant mine in the vicinity of its New Consort mine in the Barberton area and reconditioning, equipping, and exploratory development is now proceeding. Also in the area another smaller mine, the Agnes, has extended its workings into an adjoining dormant proposition which is being resampled in preparation for exploratory development. Generally the company has intensified its programme of geological investigation and prospecting in the Barberton area. Capital expenditure thereon and on shaft-sinking will continue at relatively high levels for some time. Through a subsidiary—Swaziland Mining and Exploration—the company owns mineral concessions over about 120,755 acres in Swaziland and directly concessions over 158,222 acres, portions of which are under tribute to other parties.

Buffelsfontein Gold Mining, which milled an average monthly tonnage of 148,000 tons in 1960–61 and 155,000 tons in the following four months, in a gold plant expanded to a capacity of 180,000–210,000 tons a month does not anticipate any further appreciable increase in the mining, hoisting, and milling rate until the ventilation component (22-ft. lined diameter) of the Eastern shaft system is completed about mid-1962. In the meantime three new and larger fans are being installed at the shaft system in the north-western section, the first of which has been commissioned.

The No. 2 Shaft, 26-ft. diameter, in the central section of Doornfontein Gold Mining, where preparatory operations for the start of full-scale sinking early in 1962 are well advanced, will be sunk to a depth below surface of about 6,000 ft. and is expected to be commissioned by the end of 1965. A cross-cut has been advanced from No. 1 Shaft workings to the vicinity of the underground site of No. 2 Shaft.

Venterspost Gold Mining has found that, with favourable development disclosures being obtained from the Ventersdorp Contact Reef horizon in the southern section served by No. 3 Subvertical Shaft, a re-arrangement of the underground layout has become necessary in order to achieve balanced operations on both the horizon mentioned and the deeper Main Reef and to avoid overloading the No. 2 Shaft already under strain. The main rail line crosses the mine north of the surface projection of No. 3 Subvertical and this has ruled out sinking a vertical shaft from surface to link up with the existing subvertical. Accordingly, direct access between No. 3 Subvertical and either No. 2 or 1 shafts will be provided by cutting twin high-speed haulages from No. 3 Subvertical to No. 2 and No. 1 shafts, each component being 10 ft. by 11 ft. over a total distance of 12,700 ft. and by these means achieve the desired flexibility of underground handling arrangements. Work on the haulages, already under way, should be completed by the end of 1962.

Hartebeestfontein Gold Mining estimates that the 1961–62 capital expenditure programme will be about R3,300,000 mainly on the No. 4 Shaft system in the south-western section. Sinking has now been completed to a final depth of about 7,400 ft. and the shaft should be in commission within the next two months or so with hoisting to be conducted in two stages. An interesting feature of sinking procedure was the substitution of caterpillar mechanical loaders, operating on the shaft bottom, for the mechanical grab over the last 1,800 ft. or so. This was done apparently to lighten the load on the sinking-stage at depth and, in turn, to lighten the overall load on the stage-ropes.



No. 3 Shaft, Loraine Gold Mines.

Harmony Gold Mining has discontinued gravity concentration of gold in its mill and has converted the gold plant to full cyanidation operation. The main reasons for the conversion apparently lie in relative costs, increasing security arrangements, and reducing handling.

Blyvooruitzicht Gold Mining has adopted and is extending the long-wall stoping technique at depth in the eastern and central sections of the mine in the higher-grade zone, one reason being that this technique does not require advance horizontal development on the reef plane. Preparatory operations for the sinking of the B line of four sub-incline shafts to the 8,500-ft. horizon at the southern boundary has so progressed that sinking proper is expected to be initiated early in 1962.

Central African Federation.—Bancroft Mines, which in 1960–61 milled an average of 160,150 tons a month with a recoverable content of 51,775 long tons of blister copper in the year, is to embark on an expansion programme to raise output to about 63,000 long tons and increase the milling rate to about 220,000 tons monthly. The programme includes opening up the No. 3 Shaft area north of No. 1 Shaft, the former to have a production target of 100,000 tons a month of ore with output from the latter to be scaled down to about 120,000 tons monthly. The capital expenditure will be an estimated £6,500,000 over the next three years, covered to the amount of £2,625,000 by a share issue.

The Rhokana Corporation has obtained encouraging results from a programme of prospecting in the Mindola North Extension and the Nkana Syncline oxide zone, where operations continue to facilitate an assessment of the economic potential. Cobalt production has encountered difficulties in recovery due to

a lower overall grade and an unexpected change in cobalt mineralization and research is being directed to overcome these difficulties.

Mufulira Copper Mines last year produced an average monthly tonnage of 450,965 tons of ore, against the previous figure of 407,826 tons, the respective recoverable anode-grade copper being 101,326 and 103,539 long tons in the two years. The increased tonnage output was due to the progressive implementation of the Mufulira West expansion project, expected to be completed by about mid-1962. Copper output has continued to be curtailed. Stoping in the Mufulira West section was initiated in the year. Extensions to the surface plant have reached an advanced stage, the structural work has largely been completed, the first three grinding units and ancillary flotation units, regrind mills, etc., have been installed and should now be in commission and the installation of equipment in the Symons crusher and screening plant has been started. Block caving methods, the application of which has been extended, accounted for 78·3% of the tonnage broken in 1960–61. The undercutting rate has been improved by extending the use in undercuts of long blastholes drilled to pattern and experiments to improve performances further continue. In one section pre-weakening has been re-introduced to assist caving after undercutting and to reduce secondary blasting. The extended use of block caving and the reduced open stoping accords with the curtailment policy in so far as it permits feeding lower-grade ore to the surface plant.

South-West Africa.—The second company to be formed for off-shore exploration and winning of diamonds along the coastline is the Atlantic Diamond Corporation, Ltd., which has taken over concessions in respect of an 8-mile stretch north of the Orange River. Two vessels have already been acquired for the purpose. The first company established for these operations is the Marine Diamond Corporation, Ltd., which has concessions over 117 miles between the Orange River and Luderitz.

Tsumeb Corporation, Ltd., which operates a 60,000-ton-a-month differential flotation plant producing copper, lead, zinc, and germanium concentrates and a germanium reduction plant which produces a semi-refined germanium oxide product is expanding the germanium reduction plant. It also has under construction a copper smelter with an annual blister-copper output capacity of 35,000 tons and a lead smelter and lead refinery with an annual refined-lead output capacity of 90,000 tons respectively scheduled for commissioning by mid-1962 and mid-1963.

Trade Notes

Brief descriptions of developments of interest to the mining engineer

Shuttle Mine Car

A 10-ton payload shuttle mine car which has been developed at the instigation of Stewarts and Lloyds (Minerals), Ltd., is now offered by **Aveling-Barford, Ltd.,** of Grantham. The new machine is shown in the illustration and it will be seen that it is suitable for underground work. This has been achieved by setting operator's seat and controls closer to the footplate than on the company's standard dumper, dispensing with drive axle leaf springs, and by fitting a specially-designed body. This latter has an exceptionally low lip at the scow end, for operation with any underground loader likely to be teamed with it. Loading height is only 4 ft. 10½ in., yet capacity is 7 cu. yd. heaped.

A feature of special relevance to underground work is the reversible driving seat and dual controls which the company first incorporated into dumpers nearly 15 years ago. Thus the operator always faces his direction of travel and in confined areas the Minecar can be reversed instead of laboriously turned around with

numerous back-ups. The standard transmission giving four forward and two reverse speeds between 4·23 m.p.h. and 24·5 m.p.h. is satisfactory where conditions allow reasonably fast transportation. Where there are exceptional hazards, however, such as deep, heavy mud, an alternative reduction gear can be fitted into the drive axle to reduce road speeds and so allow the full range of gears to be used. This is advantageous underground in that exhaust discharge has less toxic content than would be emitted from a standard transmission type. Power-to-weight ratio is 6·58 b.h.p. per short ton laden and a torque of 292-lb.-ft. at 2,600 r.p.m. is produced by the 133-b.h.p. Leyland six-cylinder engine.

A number of prototypes have been in continuous operation for the past 18 months at the Thistleton, Rutland, ironstone drift mine and production units are now in operation at this mine and at the nearby Easton mine of the United Steel Companies, Ltd. Another unit, especially modified to enable it to carry explosives underground is to be delivered shortly to Thistleton.

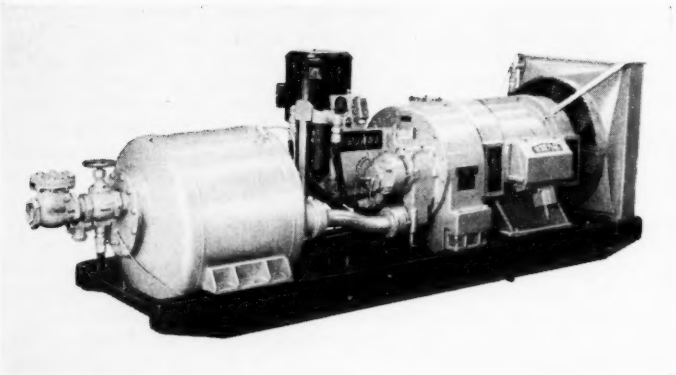
Rotary Air-Compressor

A new addition to their range of rotary air-compressors is announced by the Air Power Division of **Joy-Sullivan, Ltd.**, of 7, Harley Street, London, W. 1. This, which is illustrated here, is the RE.600, an electrically-driven two-stage rotary-vane oil-flooded type with a free air delivery of 600 c.f.m. at 100 p.s.i.g. Maximum operating pressure is 120 p.s.i.g. Designed for heavy-duty applications, the RE.600 is mounted on a robust channel section steel skid, with or without rail wheels and is particularly suitable for underground operations in which the demand is for an easily moved unit that can be kept close to the workface. Leakage and friction losses in the piping are reduced to a minimum and there is no necessity for a bulky air receiver.

The design of the new model is identical to that of the portable unit of similar capacity and incorporates a side-by-side cylinder arrangement housed in a one-piece cast-iron stator housing, with helical gear drive between l.p. and h.p. rotors. Full provision is made to prevent rotor end play while allowing for expansion and contraction. A hardened bevel on the trailing edges of the rotor slots minimizes vane wear and the counter-bored cylinder ensures adequate internal air sealing. Compressor and motor are coupled as a compact unit in an oil-flooded gearbox, helical gearing giving a speed increase of 0·77 : 1. No clutch is required between electric motor and compressor. The Brush electric motors fitted develop a maximum of 160 b.h.p. at 1,440 r.p.m. A choice of squirrel-cage screen-protected, totally-enclosed fan-cooled, or totally-enclosed flameproof motors can be supplied to Buxton certified standard.

Aveling-Barford Minecar.

Joy-Sullivan Rotary Air-Compressor.



Voltages are 440–600 v. and 2,750–3,300 v., 50-cycle supply. The motors are specially designed and incorporate a flange for direct mating to the gearbox.

The RE.600 has a " fail-safe " circuit which will stop the compressor should the air discharge temperature exceed 225° F. Units can operate safely in ambient temperatures up to 125° F. More elaborate " fail-safe " systems can be fitted to meet particular requirements. For easy transportation the skid mounting is designed so that it can be split into two sections, one carrying the compressor, heat exchanger, electric motor, and gearbox; the other carrying the air receiver, air/oil separator, filters, and accessories.

Personal

Sir EDWARD ASAFU-ADJAYE has been appointed a director of the Consolidated African Selection Trust, Ltd.

T. P. S. BAXTER is now manager of the United Steel Companies' Dragonby mine.

H. C. T. BROWN is here from South West Africa.

J. V. F. CROWTHER has been elected a director of the Central Provinces Manganese Ore Company.

J. DARRAGH has been appointed manager of the United Steel Companies' Santon mine.

L. E. ELKINS has been elected president of the American Institute of Mining, Metallurgical and Petroleum Engineers for 1962.

K. L. FETTERS has been elected president of the Metallurgical Society of A.I.M.E. for 1962.

F. IBBOTSON has been appointed assistant group manager of the United Steel Companies' underground mines.

J. G. B. MICHELL has left for the Philippines.

M. E. PEASE has been elected a director of the Lampa Mining Co., Ltd.

J. R. RUDD has been appointed a director of De Beers Consolidated Mines, Ltd.

J. GORDON SMITH has left Cyprus for Eire.

WILLIAM B. STEPHENSON has been elected president of the A.I.M.E. Society of Mining Engineers for 1962.

M. D. STOAKES is shortly returning from Tanganyika.

R. J. SUTCLIFFE has resigned as chairman of Richard Sutcliffe, Ltd., and the Sutcliffe Moulded Rubber Co., Ltd., being succeeded in these positions by E. D. SUTCLIFFE and W. F. G. SUTCLIFFE.

VICTOR WALKER has left for Peru.

P. W. WATSON has left for Ghana.

D. M. WILLIAMS has returned from Canada.

JOHN WHITEHEAD has joined the Craelius Company in London.

EDWIN GREGORY died on November 7, aged 67. Dr. Gregory had been a director of Edgar Allen and Co., Ltd., for 15 years and was chief metallurgist to the company from 1944 until his retirement in March last.

THE INSTITUTION OF MINING AND METALLURGY

Elections and Transfers

Member.—D. G. MAXWELL, A.R.S.M., B.Sc. (*Johannesburg*); F. O. READ, B.Sc. (*Johannesburg*); Albert ROBERTS, Ph.D. (*Sheffield*); Gerald THORBURN (*Welkom, O.F.S.*); R. G. WEAVIND, M.Sc. (*Johannesburg*).

Associate Member to Member.—A. G. GILFILLAN, B.Sc. (*Johannesburg*); H. A. HALUPTA, B.Sc. (*Shawville, Quebec*); John MACKENZIE, B.Sc. (*Baguio, Philippines*); P. G. C. THOMAS (*Prestea*); T. G. TURNBULL (*Konongo*).

Associate Member.—John DARRAGH (*Scunthorpe*); P. McL. D. DUFF, B.Sc. (*Edinburgh*); B. M. MANIAR, E.M., M.S. (*Bombay*); J. A. S. MOWAT, M.A., M.Sc. (*Thurso*); J. F. OSTEN, Ph.D. (*Lusaka*); W. G. B. PHILLIPS, A.R.S.M., B.Sc. (*Dar-es-Salaam*); J. L. STOLLERY, B.Sc. (*Croydon*); J. E. STRUTHERS, B.Sc., A.R.T.C. (*re-instatement*); D. L. WOOLF, B.Sc. (*Sandaken, British N. Borneo*).

Student or Affiliate to Associate Member.—P. W. ANDREWS, A.R.S.M., B.Sc. (*Port Arthur, Ont.*); Gordon FATKIN, Ph.D. (*Sheffield*); H. D. GREEN, A.C.S.M. (*Maracaito*); S. J. GRIFFITHS, B.E. (*Tennant Creek, N.T.*); E. K. HART, A.O.S.M. (*Broken Hill, N.S.W.*); C. T. HOLLICK, A.R.S.M., B.Sc. (*Stevenage*); M. R. HORNBY, A.C.S.M. (*Eiffel Flats, S. Rhodesia*); E. G. LOMAX, A.R.S.M., Ph.D. (*Mansfield Woodhouse*); D. M. MACPHERSON, A.R.S.M., B.Sc. (*Neath*); C. N. OKEZIE, M.S., A.R.S.M., B.Sc. (*Enugu, Nigeria*); P. H. PHILLIPS, Ph.D. (*Stoke-on-Trent*); C. G. READ, A.R.S.M., B.Sc. (*West Wickham*); Mohammed SALLEH, A.C.S.M. (*Kuala Lumpur*); M. L. THOMAS, A.C.S.M. (*Warwick*).

Affiliate.—R. A. F. ADEJUMO (*Barakin Ladi*); W. T. BENNETTS (*Tarkwa*); W. J. EDWARDS (*Barakin Ladi*).

Student.—P. H. APPS, A.R.S.M., B.Sc. (*London*); S. V. BELL, B.Sc. (*Volta Region, Ghana*); Roger BILLINGHAM (*London*); J. D. CARLISLE (*Birmingham*); A. H. CLARK (*Manchester*); M. D. DALE (*Birmingham*); T. W. FRIESE-GREENE (*London*); G. J. HACLIN (*London*); M. J. HILLBECK (*Birmingham*); G. R. HOBBS, B.Sc. (*Stevenage*); C. B. HUGGINS (*Camborne*); Umit IMRE (*Birmingham*); F. P. KERR (*London*); Richard McLAREN (*London*); A. M. MANN (*Birmingham*); G. A. MANSON (*London*); M. N. MIAN, B.Sc., D.I.C. (*Lahore*); S. S. NASIM (*Camborne*); M. Z. PAPADOPOULOS, B.Sc. (*Leeds*); M. W. PHILPOTT (*London*); M. M. PRITCHETT (*London*); A. H. RICHARDSON (*London*); Angus ROBB, B.Sc. (*Luanshya*); Howard ROSE (*Sheffield*); R. A. A. SEYMOUR (*Birmingham*); Hugh SQUAIRE, B.A. (*London*); David TENNEY, B.Sc. (*London*); D. R. WILLIAMSON (*Camborne*); J. A. WILSON, (*London*).

Metal Markets

During November [1]

Copper.—Labour problems have again been quite an important feature of the copper market in November.[2] The strike at Mount Isa, Australia, persisted in the early part of the month and might have lasted longer but for strong action by the Queensland authorities—not, however, before a considerable loss of copper, revenue, and profit had been sustained. Meanwhile Chile has remained an uneasy source of endless reports of labour unrest, Government intervention, company–Government dissension, etc. It is true that the long drawn-out discussions at the Potrerillos and El Salvador mines eventually produced a settlement at the eleventh hour, but there is now a distinct risk of a major strike at Chuquicamata. These developments have taken place against a background of growing unrest on the part of the big American-owned mines as to their future financial situation, if new proposals for even more heavy taxation on their operations are passed by the Government.

However, if the copper market sometimes seems a full-time job from the day-to-day point of view, it must also be remembered that the industry has also to keep its eye on the long-term picture. Two reminders of this in November were the opening of the new Mission mine in Arizona of American Smelting and Refining—a concrete statement of faith in the expanding future for copper despite present production restrictions—and the pointed reference by Sir Ronald Prain, of Rhodesian Selection Trust, to the remarkable growth of copper consumption in Europe in 1960—a rate of growth which Sir Ronald said had never previously been equalled in any 12-month period. November, of course, sees the issue of the annual reports of both the big Rhodesian groups and in his statement Mr. H. F. Oppenheimer said he felt the period of major expansion of world capacity was coming to an end, at the same time as he saw the growth of consumption continuing.

[1] Recent prices, pp. 328, 364.
[2] See Table, p. 364.

Certainly there was and is nothing wrong with European consumption as far as wire, almost entirely for the electrical industry, is concerned. This is reflected in the fact that despite the basic oversupply of copper on world markets, electrolytic wirebars, the wiredrawers raw material, can still command a specific delivery of up to £6 per ton over London Metal Exchange prices, the basis of which is wirebars, but wither electrolytic or fire refined ?

Against this confusing background price movements [1] have been quite modest and, despite the clouded economic outlook for the U.K. and Europe generally, there is little disposition to look for much major change in prices in the near future.

U.K. copper consumption in September was 60,028 tons, so that the nine months' total is almost 25,000 tons down on the same period of 1960. Refined copper consumption in September was 45,813 tons, while production of primary refined was 14,233 tons and of secondary refined 9,089 tons. Refined stocks fell marginally to 125,517 tons and blister stocks declined to 22,431 tons.

Tin.—The tin market in November can be largely characterized by saying that the disappointment that earlier statistical forecasts have not been more dramatically fulfilled by now really took hold of sentiment. Tin has been a dispirited market throughout the month and prices [1] have done no more than waver around the £960 mark, giving scarcely any indication of the fact that almost everybody connected with the market remains convinced that the gap between production and consumption must come to the light of day and influence prices eventually. However, there has been just enough difference between actual indications of tin consumption (especially, of course, in Europe), and the rate of consumption that was used in statistical forecasts earlier, for the market to conclude that the time at which the shortfall in supplies will actually affect consumers will only fall some way into 1962 and not about now, as seemed likely earlier. After February, however, it is likely that more will be known of U.S. intentions both in respect of stockpile releases and of joining the Agreement. Naturally this produces market caution in the meantime.

U.K. September tin use was 1,849 tons, production 2,282 tons, and stocks were down at 7,662 tons at the month-end.

Lead—November saw lead prices on the London Metal Exchange at their lowest post-war ebb and, although they have bounced back really quite well from the £58 level, sentiment is still extremely depressed. The dismal fact is that consumption this year has declined further—in many places, indeed, more than in the U.K.—while two big international conferences to attempt to secure agreement on production restriction have been virtually useless. It is true that the big Canadian and Australian producers are now compelled to maintain a rate of production restriction they introduced earlier when they might prefer to do otherwise, by virtue of the terms under which they bartered their accumulations to the U.S. stockpile. However, this restriction runs out next April. Unless the next meeting of the International Lead and Zinc Study Group is more successful than past meetings, therefore, there appears a risk of the lead market developing into a free-for-all after April. As a result of the London price decline U.S. producers lowered their price to 10 cents but took advantage of the later rebound to return to 10¼ cents.

U.K. September lead consumption was 31,359 tons, bringing the nine months' total to 273,608 tons, as compared with 282,899 tons in the same period of 1960. Production of English refined in the month was 8,701 tons, while stocks totalled 74,273 tons.

Zinc.—As far as America is concerned quite cheerful forecasts are still made about the zinc market, gaining no little support from the indication that next year's model cars will use 10% more zinc than this year's. Against this background a partial rise in the U.S. price (some producers advancing to 12 cents, which took place on December 1) seems reasonable. However, the position is less cheerful in Europe,[1] even if not as bad as in lead. On both sides of the Atlantic premiums for high-grade metal are under pressure.

U.K. September use was 28,778 tons, production 8,563 tons, and stocks dipped to 69,491 tons.

Iron and Steel.—November has seen a growing realization among British steel makers that the recession is going to last rather longer than many people had hoped earlier. It seems increasingly likely that the process of stock reduction will go on for some months yet and with still no sign of any general upturn in steel demand a marked increase in the flow of business to the steel mills cannot now be expected until after the summer holidays next year.

The situation in the steel trade is, of course,

[1] See Table, p. 364.

[1] See Table, p. 364.

not catastrophic. Consumption generally is good and many works are quite busy, especially the strip and tinplate mills. However, the flow of orders for many products is not equal to the rate of deliveries at the moment and anxious days are ahead for the heavy mills, especially the plate markers. Delivery delays for almost all steel products are now measured in days rather than weeks.

Strenuous efforts on the export markets boosted shipments abroad to 2·84 million tons in the first ten months of the year from 2·75 million tons in the same period of 1960. In these exports, however, is included a certain amount of steel rolled here on toll for Russia and recently more of this business has been accepted, mostly covering coil into sheets and billets into rods and rounds. This has been welcome at a time when rolling capacities here are not fully utilized.

Iron Ore.—The lower demands for basic iron from the steel-melting shops is having a depressing effect upon imports of iron ore. Arrivals in the first ten months of this year at 13,143,886 tons were over 2,000,000 tons below the amount imported in the same period of 1960. Current production of domestic iron ore is substantially lower compared with the earlier part of the year, but total production in 1961 is slightly above last year.

Aluminium.—The past month has seen little change on the aluminium market, which means that competition is still the order of the day. Nevertheless, there has been seen a number of further manifestations of the expansionist mentality of the industry, or, as cynical observers are apt to put it, "capacity madness." It is now trite to repeat that on the basis of today's aluminium consumption the world has probably 1,000,000 tons of idle capacity (out of just over 4,000,000), of which half is in North America. Nevertheless, people both in and out of the aluminium business in all parts of the world remain interested in establishing new plants and, because of the demonstrated economic unsuitability of building small plants, they all want to build large to giant units. Two new plants which have been proposed in Europe in the past month reflect this, for both passed without comment yet one was for 60,000 tons and the other 100,000 tons a year. The 60,000-ton plant has been proposed for North Holland by Billiton. They already have plenty of bauxite and there is local natural gas. In Italy Montecatini has now as good as confirmed earlier reports that the group would build a big new plant in Sardinia. Such a plant must, of course, be based on expanding consumption within the Six, but forgets that this consumption is already more than fully satisfied.

In the U.K. the home price remains £186.

Antimony.—The antimony metal and ore market have been somewhat featureless during the month under review. Prices have been maintained at the same level as for the past few months for 60% ore at from 26s. to 28s. per unit c.i.f., although on the Continent smelters are now paying rather less fantastic prices than they were. Domestically-produced 99% regulus is still quoted at £230 per ton and 99·6% £237 10s. per ton.

Arsenic.—So far this year the general position of arsenic has remained fairly dull and nothing has changed in November. The price of metallic arsenic in the U.K. is still held at £400 per ton and of arsenic trioxide at £40 to £45 per ton.

Cobalt.—The biggest surprise in the cobalt market during the past month was an increase in the U.K. price to contract buyers from 10s. 9d. to 10s. 10d. per lb., coming at a time when the market situation hardly warranted a rise in prices. To others, however, the price remains at 12s. The prospect of plentiful world supplies is still apparent.

Cadmium.—During November the sellers of U.K. and Empire cadmium advanced their U.K. selling price to 11s. 6d. per lb. from 11s. per lb. This long-awaited rise still leaves U.K. prices slightly below world parity, reflecting the fact that consumption is still below its highest peak.

Chromium.—The domestic price for this commodity remains at 6s. 11d. to 7s. 4d. per lb. There was no change in the state of the chromium market in November.

Tantalum.—The current price per unit c.i.f. for a good 60% ore is still 1,600s. to 1,700s. Throughout the past month the market has been strong with demand holding up well.

Platinum.—Throughout November the platinum market has been quite featureless. The big producers continued to meet the contractual demands of their customers. The U.K. prices remain the same at £30 5s. per oz. for this material and at £27 10s. to £28 for "open market" material.

Iridium.—This market has been extremely quiet throughout the past month. The prospect of any change in the state of the iridium market in the near future is still unclear. The U.K. price has been held steadily at £20 to £26 15s. per troy oz.

Palladium.—The palladium market has been quite steady throughout November and the U.K. price has been maintained at £8 10s. to

£9 15s. per troy oz., depending upon whether the seller is offering Russian or Western material.

Tellurium.—The outlook for tellurium continues to look bright. The supply of this metal is definitely limited and established users are not always able to secure quantities readily additional to their historical allocation from their regular suppliers, but for the time being the price remains at 37s. 6d. per lb. Stocks are still quoted nominally.

Osmium.—The osmium market has been quite uninteresting throughout November. The price is still held at £17 to £25 per troy oz.

Tungsten.—The tungsten-ore market has aroused a good deal of interest in the past month. The current quotation for tungsten ore is 89s. to 92s. c.i.f. per long ton unit for Contract "B" material—a considerable drop from the levels recorded in October (which were themselves a considerable drop from the previous month). The blame for the present state of the market falls on many heads. Sales from the Sino-Soviet Bloc on the Continent have considerably reduced day-to-day selling activity in that market. The stocks of ore held by the British Government have been considered a threat to the market and a statement from this body would definitely improve sentiment, but the main factor must be the present position, where there is currently rather more than enough material available to meet demand. Indications are, however, that things might improve. The market has of late developed a steadier tone and it appears that this might further improve to a firmer tone.

Nickel.—The nickel market has been quite routine throughout November and the price is still quoted at £660 per ton. At the same time it must be a disappointment to nickel producers, who today have more metal than ever before to sell, that stainless-steel activity in Europe is no better than it is.

Chrome Ore.—The chrome-ore market has remained very quiet throughout the past month. The price for Rhodesian metallurgical remains at £15 5s. per ton c.i.f. The official Turkish export price for chrome ore remains at $30 per ton f.o.b.

Molybdenum.—The molybdenite market has continued healthy in September; there has, however, been a decline in the insistence of demand from a few directions. The price remains at 10s. per lb. Mo.

Manganese.—Manganese ore has been quite quiet throughout November. The c.i.f. Europe price continues to be indicated at 66d.–69d. per unit for 46%–48% ore.

Tin, Copper, Lead, and Zinc Prices

Tin, minimum 99·75%; Copper, electro; Lead, minimum 99·75%; and Zinc, minimum 98%, per ton.

Date	Tin				Copper				Lead				Zinc			
	Settlement		3 Months		Spot		3 Months		Spot		3 Months		Spot		3 Months	
	£	s.	£	s.	£	s.	£	s.	£	s.	£	s.	£	s.	£	s.
Nov. 10	972	10	973	10	228	12½	228	17½	60	0	60	16¼	68	13¾	69	11½
13	968	0	970	15	229	7½	229	12½	59	7½	60	7½	68	13¾	69	13¾
14	962	10	966	10	227	12½	227	12½	57	12½	58	13¾	67	11¼	68	13¾
15	962	0	968	5	229	7½	228	17½	58	11¼	59	17½	68	11¼	69	16¼
16	964	10	970	10	229	2½	228	17½	58	8¾	59	11¼	67	3¾	68	13¾
17	967	0	972	15	229	2½	228	17½	59	0	60	6¼	67	18¾	69	6¼
20	966	0	971	0	229	12½	229	7½	58	3¾	59	8¾	67	15	68	17½
21	961	0	967	10	229	0	228	12½	59	3¾	60	7½	68	6½	69	6¼
22	960	0	966	5	228	17½	228	7½	59	13¾	60	17½	68	13¾	69	17½
23	961	0	967	10	229	17½	229	7½	61	17½	62	15	70	2½	71	8¾
24	961	0	966	15	229	7½	229	2½	61	7½	62	7½	70	1¼	71	1¼
27	956	0	961	10	229	2½	229	2½	61	12½	62	13¾	70	13¾	71	15
28	962	0	959	10	229	2½	229	2½	61	18¾	62	17½	71	8¾	72	15
29	950	0	961	10	227	12½	228	2¼	61	3¾	62	3¾	71	8¾	72	11¼
30	950	0	960	10	228	2½	228	2½	60	2½	60	17½	70	6¼	71	8¾
Dec. 1	957	0	963	10	228	7½	228	7½	60	17½	61	16¼	71	1¼	72	8¾
4	956	0	962	10	228	7½	228	7½	60	8¾	61	7½	71	3¾	72	3¾
5	952	0	959	15	228	5	228	7½	60	1¼	61	3¾	70	6¼	71	11½
6	953	0	962	10	228	17½	228	17½	60	3¾	61	6¼	70	8¾	71	11½
7	953	0	962	10	229	17½	230	2½	60	8¾	61	13¾	70	13¾	71	16¼
8	—		—		—		—		—		—		—		—	
11	—		—		—		—		—		—		—		—	

Statistics

TRANSVAAL AND O.F.S. GOLD OUTPUTS

	October		November	
	Treated Tons	Yield Oz.†	Treated Tons	Yield Oz.*
Blyvooruitzicht	142,000	88,119	142,000	88,146
Brakpan	146,000	18,978	142,000	18,774
Buffelsfontein‡	157,000	69,491	157,000	69,740
City Deep	117,000	24,456	116,000	24,254
Cons. Main Reef	38,000	8,501	34,000	7,814
Crown Mines	171,000	29,826	176,000	30,275
Daggafontein	228,000	46,013	227,000	46,021
Dominion Reefs	42,500	—	49,000	—
Doornfontein‡	125,000	54,069	126,000	54,608
D'rb'n Roodeport Deep	206,000	38,744	199,000	37,414
East Champ D'Or‡	12,500	244	12,500	212
East Daggafontein	109,000	18,934	109,000	19,207
East Geduld	122,000	34,282	121,000	34,001
East Rand P.M.	233,000	56,415	244,000	59,391
Eastern Transvaal Consol	20,600	6,064	20,600	5,989
Ellaton‡	23,000	5,521	22,000	5,394
Freddies Consol	65,000	12,589	65,000	12,703
Free State Geduld	100,000	87,910	100,000	87,911
Free State Saaiplaas	67,000	18,389	70,000	18,925
Geduld	74,000	12,327	73,000	11,757
Government G.M. Areas‡	32,000	7,451	31,000	7,264
Grootvlei Proprietary	230,000	46,840	230,000	46,841
Harmony Gold Mining	197,000	79,541	198,000	79,896
Hartebeestfontein‡	136,000	62,560	136,000	62,563
Libanon	119,000	31,531	119,000	32,045
Loraine	85,000	29,537	85,000	30,175
Luipaards Vlei‡	110,000	14,166	110,000	14,068
Marievale Consolidated	99,000	23,523	99,000	23,532
Modderfontein East	64,000	6,135	67,000	6,089
New Kleinfontein	71,000	9,937	70,000	9,959
New Klerksdorp‡	—	—	—	—
President Brand	133,000	102,789	133,000	102,540
President Steyn	114,000	42,651	115,000	42,573
Rand Leases	163,000	23,309	154,000	23,485
Randfontein‡	104,000	8,710	103,000	8,251
Rietfontein Consolid't'd	12,000	3,102	12,000	3,047
Robinson Deep	50,000	9,870	52,000	10,012
Rose Deep	25,000	4,295	22,000	3,698
St. Helena Gold Mines	187,000	65,454	190,000	68,408
Simmer and Jack	71,000	12,365	69,000	12,160
S. African Land and Ex.	110,000	22,387	110,000	22,385
S. Roodepoort M.R.	30,000	7,314	30,000	7,340
Spaarwater Gold	11,200	3,618	11,200	3,569
Springs	99,000	14,354	100,000	14,436
Stilfontein Gold Mining‡	190,000	84,960	195,000	86,970
Sub Nigel	66,500	15,155	66,500	15,260
Transvaal G.M. Estates	—	—	—	—
Vaal Reefs‡	123,000	57,810	123,000	57,810
Van Dyk Consolidated	74,000	10,601	73,000	10,514
Venterspost Gold	130,000	39,351	129,000	39,442
Village Main Reef	35,900	4,488	35,500	4,384
Virginia O.F.S.‡	136,000	27,921	140,000	28,084
Vlakfontein	53,000	19,631	53,000	19,629
Vogelstruisbult‡	80,000	17,293	80,000	17,212
Welkom Gold Mining	107,000	34,291	111,000	33,553
West Driefontein‡	182,000	142,879	184,000	144,355
West Rand Consol.‡	221,000	23,233	213,000	22,001
Western Holdings	175,000	123,375	175,000	123,812
Western Reefs	155,000	45,182	153,500	44,900
Winkelhaak	98,000	33,321	97,000	32,980
Witwatersrand Nigel	19,500	4,279	19,500	5,394

* 249s. 7d. † 249s. 7d. ‡ Gold and Uranium.

COST AND PROFIT IN THE UNION *

	Tons milled	Yield per ton	Work'g cost per ton	Work'g profit per ton	Total working profit
		s. d.	s. d.	s. d.	£
Sept., 1960	18,103,100	74 0	46 4	27 8	32,201,685
Oct.	—	—	—	—	—
Nov.	—	—	—	—	—
Dec.	17,272,800	76 2	47 0	29 2	33,039,583
Jan., 1961	—	—	—	—	—
Feb.	—	—	—	—	—
Mar.	17,858,100	—	—	—	31,924,315
April	—	—	—	—	—
May	—	—	—	—	—
June	16,419,350	—	—	—	65,772,460†
July	—	—	—	—	—
August	—	—	—	—	—
September	18,558,700	—	—	—	67,147,350†

* 3 Months. † R.

PRODUCTION OF GOLD IN SOUTH AFRICA

	Rand and O.F.S.	Outside	Total
	Oz.	Oz.	Oz.
November, 1960	1,775,624	36,159	1,811,783
December	1,744,406	34,044	1,778,450
January, 1961	1,785,614	34,407	1,820,021
February	1,759,373	32,046	1,791,419
March	1,837,280	38,843	1,876,123
April	1,837,511	29,437	1,866,948
May	1,885,415	42,062	1,927,477
June	1,887,594	35,858	1,923,452
July	1,899,248	34,977	1,934,225
August	1,926,670	40,346	1,967,016
September	1,921,304	37,228	1,958,532
October	1,928,466	40,276	1,968,742

NATIVES EMPLOYED IN THE SOUTH AFRICAN MINES

	Gold Mines	Coal Mines	Total
February 28, 1961	396,533	33,577	430,110
March 31	398,626	33,736	432,362
April 30	398,012	34,005	432,017
May 31	396,437	33,587	430,024
June 30	392,591	33,180	425,771
July 31	389,255	33,200	422,455
August 31	382,733	33,244	415,977
September 30	381,659	33,203	414,862
October 31	386,239	32,945	419,184

MISCELLANEOUS METAL OUTPUTS

	4-Week Period To Nov. 11		
	Tons Ore	Lead Concs. tons	Zinc Concs. tons
Broken Hill South	—	—	—
Electrolytic Zinc	21,243	1,053	6,115
Lake George	—	—	—
Mount Isa Mines**	—	—	—
New Broken Hill	56,826	5,695	13,640
North Broken Hill	28,043	5,044	5,287
Zinc Corp.	50,574	7,264	11,295
Rhodesia Broken Hill*	—	—	—

* 3 Months, ** Copper 560 tons blister; 1,545 tons concs.

RHODESIAN GOLD OUTPUTS

	Oct.		Nov.	
	Tons	Oz.	Tons	Oz.
Cam and Motor	—	—	—	—
Falcon Mines	22,400	4,525	22,000	4,444
Globe and Phœnix	4,750	2,695	—	—
Motapa Gold Mining	12,214	—	—	—
Mazoe	2,687	—	2,849	—
Coronation Syndicate	—	—	12,798	—
Phœnix Prince*	—	—	—	—

* 3 Months.

WEST AFRICAN GOLD OUTPUTS

	Oct.		Nov.	
	Tons	Oz.	Tons	Oz.
Amalgamated Banket	—	—	—	—
Ariston Gold Mines	—	—	—	—
Ashanti Goldfields	38,500	33,000	39,000	33,250
Bibiani	—	—	—	—
Bremang	—	—	—	—
Ghana Main Reef	—	—	—	—
Konongo	7,900	3,954	7,400	3,985
Lyndhurst	—	—	—	—

PRODUCTION OF GOLD AND SILVER IN RHODESIA

	1960		1961	
	Gold (oz.)	Silver (oz.)	Gold (oz.)	Silver (oz.)
January	44,902	29,711	47,673	22,101
February	45,754	29,865	44,164	13,250
March	45,309	29,656	52,507	7,256
April	48,607	6,847	50,090	7,992
May	47,542	62,912	—	—
June	45,884	34,298	51,497	7,129
July	44,865	33,323	48,088	8,070
August	48,284	28,931	46,141	6,456
September	48,865	38,951	—	—
October	47,473	37,308	—	—
November	46,439	33,896	—	—
December	48,778	26,327	—	—

WESTRALIAN GOLD PRODUCTION

	1959	1960	1961
	Oz.	Oz.	Oz.
January	63,924	64,794	62,434
February	65,035	66,789	73,271
March	65,408	61,941	69,360
April	62,686	65,373	62,569
May	64,184	66,682	66,352
June	74,590	74,902	81,562
July	78,974	67,623	61,886
August	68,546	67,466	71,894
September	66,501	68,794	67,831
October	70,427	67,310	69,339
November	68,858	107,815	—
December	117,474	76,269	—
Total	861,122	855,758	—

AUSTRALIAN GOLD OUTPUTS

	4-Week Period			
	To Oct. 10		To Nov. 7	
	Tons	Oz.	Tons	Oz.
Central Norseman	13,739	7,212	14,101	6,974
Gold Mines of Kalgoorlie	40,428	11,667	40,347	12,295
Gt. Boulder Gold Mines*	—	—	—	—
Gt. Western Consolidated	33,072	4,989	30,269	4,800
Lake View and Star*	186,255	42,453	—	—
North Kalgurli	28,025	5,651	—	—
Sons of Gwalia	12,346	2,888	—	—
Mount Morgan	—	3,834	—	2,649

* 3 Months.

ONTARIO GOLD AND SILVER OUTPUT

	Tons Milled	Gold Oz.	Silver Oz.	Value Canad'n $
June, 1960	791,488	223,833	49,765	7,756,490
July	779,426	222,179	37,002	7,664,968
August	712,792	202,025	35,722	6,883,254
September	772,984	208,019	29,251	7,114,785
October	805,753	228,914	33,808	7,860,787
November	785,133	230,377	31,149	7,917,352
December	783,501	229,639	37,560	8,020,961
January, 1961	804,026	227,771	27,776	7,901,743
February	737,859	214,763	33,291	7,465,046
March	814,951	234,228	34,181	8,128,958
April	770,931	225,836	32,949	7,842,394
May	794,700	233,162	34,071	8,088,356
June	762,113	210,470	33,080	7,626,339
July	698,924	201,746	30,333	7,308,414
August	706,283	196,926	28,900	7,200,769
September	683,267	186,170	29,633	6,744,240

MISCELLANEOUS GOLD AND SILVER OUTPUTS

	Oct.		Nov.	
	Tons	Oz.	Tons	Oz.
Clutha River	—	570	—	464
Lampa (Peru)†	—	49,542	—	—
New Guinea Goldfields	4,122	917	—	—
Yukon Consol.	—	$318,000	—	—

† Oz. Silver : Copper, 166 tons ; 154½ tons .

AUSTRALIAN BASE-METAL OUTPUTS

Period	Concentrate Production (Long Tons)		
	Zinc	Copper (*a*)	Lead
1960	290,596	104,889	297,510
Provisional			
1961—January	15,070	8,169	15,540
February	26,716	8,265	26,437
March	27,535	9,680	26,146
April	23,759	9,548	21,279
May	29,032	9,017	28,155
June	28,259	8,821	28,669
July	24,856	8,976	22,827
August	—	—	—
September	—	—	—
October	—	—	—
November	—	—	—
December	—	—	—

(*a*) includes Cu content of direct smelting ore.

OUTPUTS OF MALAYAN TIN COMPANIES IN LONG TONS OF CONCENTRATES

	Sept.	Oct.	Nov.
Ampat Tin	61½	57½	50
Austral Amalgamated	—	—	—
Ayer Hitam	315*	—	—
Berjuntai	258	243½	226
Chenderiang	21½	—	—
Gopeng Consolidated	169	178	—
Hong Fatt (Sungei Besi)	—	—	—
Hongkong Tin	75	—	—
Idris Hydraulic	27	30	—
Ipoh	9	9	—
Kampong Lanjut	184½	182	164
Kamunting	117	79½	81
Kent (F.M.S.)	42	27	—
Kepong	66*	—	—
Killinghall	12	—	—
Kinta Kellas	13½	28½	29
Kramat	36	40	36
Kuala Kampar	137½	138	145
Kuala Lumpur	—	—	—
Kuchai	—	—	—
Larut	21	19	24½
Lower Perak	155½	188	151
Malayan	174	182	191
Pacific Tin Consolidated	—	—	—
Pahang Consolidated	634*	—	—
Pengkalen	52	56½	—
Petaling Tin	90	108½	97
Rahman Hydraulic	—	29	—
Rambutan	17	21½	—
Rantau	59½	66	60
Renong	—	—	—
Selayang	—	—	—
Siamese Tin Syndicate (Malaya)	40	40	38
Southern Kinta	380	404	466
Southern Malayan	272	232	223
Southern Tronoh	36*	—	—
Sungei Besi	459*	—	—
Sungei Kinta	—	—	—
Sungei Way	474*	—	—
Taiping Consolidated	37	47½	45
Tanjong	57	72	—
Tekka	—	—	—
Temoh	—	—	—
Tongkah Harbour	151	236	160
Tronoh	503*	—	—

* 3 Months.

NIGERIAN MINE OUTPUTS (TONS)

	Aug.	Sept.
Cassiterite	883	1,037
Columbite	225	243
Felspar	—	—
Gold*	60	54
Kaolin	—	—
Lead Ore	—	—
Limestone	67,236	61,506
Monazite	1	—
Oil†	—	1,920,497
Tantalite	2	2
Thorite	—	—
Tin Metal	70	46
Wolfram	—	—
Zircon	44	23

* Oz. † Barrels

MISCELLANEOUS TIN COMPANIES' OUTPUTS IN LONG TONS OF CONCENTRATES

	October		November	
	Tin	Columbite	Tin	Columbite
Amalgamated Tin Mines	383	68	398	—
Anglo-Burma Tin*	149	—	—	—
Bangrin	40	—	33	—
Beralt	4	177†	6	176†
Bisichi	49	45	—	—
Ex-Lands Nigeria	50	—	41	—
Fabulosa	79	—	—	—
Geevor	58	—	—	—
Gold and Base Metal	70	6	70	5
Jantar Nigeria	15	44½	—	—
Jos Tin	11	—	—	—
Kaduna Prospectors	6½	—	5½	—
Kaduna Syndicate	22	—	26	—
Katu Tin	11	—	17	—
Keffi Tin	—	—	—	—
London Nigerian Mines	—	—	—	—
Mawchi Mines	—	—	—	—
Naraguta Extended	—	—	—	—
Naraguta Karama	5½	—	—	—
Naraguta Tin	—	—	—	—
Ribon Valley (Nigeria)	—	—	—	—
Siamese Tin Syndicate	113	—	123	—
South Bukeru	—	—	—	—
South Crofty	68	—	75	—
Tavoy Tin	—	—	—	—
Tin Fields of Nigeria	—	—	—	—
United Tin Areas of Nigeria	24	2	—	—

* 3 Months. † Wolfram.

SOUTH AFRICAN MINERAL OUTPUT

September, 1961.

Gold	1,957,811 oz.
Silver	196,448 oz.
Diamonds	272,760 carats.*
Coal	3,565,574 tons.
Copper	(*a*) 17 tons in matte and copper-gold concentrates. (*b*) 4,923 tons of 99·03%.
Tin	237 tons concs.
Platinum (concentrates, etc.)	—
Platinum (crude)	—
Asbestos	16,899 tons.
Chrome Ore	93,429 tons.
Manganese Ore	136,943 tons.
Lead Concs.	— tons.

* *August, 1961.*

IMPORTS OF ORES, METALS, ETC., INTO UNITED KINGDOM

		Sept.	Oct.
Iron Ore	tons	1,246,383	1,214,340
Manganese Ore	,,	46,478	29,804
Iron and Steel	,,	43,615	61,126
Iron Pyrites	,,	33,746	22,953
Copper Metal	,,	31,748	43,546
Tin Ore	,,	2,237	3,922
Tin Metal	,,	170	60
Lead	,,	15,166	13,648
Zinc Ore and Conc.	,,	15,637	20,933
Zinc	,,	11,110	11,894
Tungsten Ores	,,	511	532
Chrome Ore	,,	11,600	12,058
Bauxite	,,	40,887	23,912
Antimony Ore and Concs.	,,	1,057	1,152
Titanium Ore	,,	23,285	16,502
Zirconium Ores and Concs.	,,	3,603	1,846
Tantalite/Columbite	,,	6	44
Sulphur	,,	26,132	42,544
Barytes	,,	3,333	1,181
Asbestos	,,	12,409	14,812
Magnesite	,,	7,644	12,108
Mica	,,	318	327
Graphite	,,	807	722
Mineral Phosphates	,,	93,021	101,985
Molybdenum Ore	,,	472	510
Silicon	,,	614	655
Nickel	cwt.	72,489	46,333
Aluminium	,,	342,494	402,586
Mercury	lb.	146,716	142,643
Bismuth	,,	—	7,358
Cadmium	,,	178,433	152,967
Cobalt	,,	252,508	395,122
Selenium	,,	8,875	14,092
Petroleum, Crude	1,000 gal.	894,957	1,093,088

Prices of Chemicals

The figures given below represent the latest available.

		£	s.	d.
Acetic Acid, Glacial	per ton	104	0	0
,, ,, 80% Technical	,,	94	0	0
Alum, Comml.	,,	25	0	0
Aluminium Sulphate	,,	16	5	0
Ammonia, Anhydrous	per lb.		1	6
Ammonium Carbonate	per ton	59	0	0
,, Chloride	,,	30	2	6
,, Nitrate	,,	36	5	0
Antimony Sulphide, golden	per lb.		4	4
Arsenic, White, 99/100%	per ton	47	10	0
Barium Carbonate 98–99%	,,	42	0	0
,, Chloride	,,	45	0	0
Barytes (Bleached)	,,	20	0	0
Benzene	per gal.		5	6
Bleaching Powder, 35% Cl.	per ton	30	7	6
Borax	,,	46	10	0
Boric Acid, Comml.	,,	77	10	0
Calcium Carbide	,,	40	17	9
,, Chloride, solid, 70/75%	,,	17	0	0
Carbolic Acid, crystals	per lb.		1	2
Carbon Bisulphide	per ton	62	10	0
Chromic Acid	,,	245	0	0
Citric Acid	per cwt.	8	14	0
Copper Sulphate	per ton	78	0	0
Creosote Oil (f.o.r. in Bulk)	per gal.		1	3
Cresylic Acid, refined	,,		8	2
Hydrochloric Acid 28° Tw.	per carboy		13	6
Hydrofluoric Acid, 59/60%	per lb.		1	1
Iodine	per kilo		17	4
Iron Sulphate	per ton	3	7	0
Lead, Carbonate, white	,,	108	5	0
,, Nitrate	,,	112	0	0
,, Oxide, Litharge	,,	96	15	0
,, Red	,,	94	15	0
Lime Acetate, brown	,,	40	0	0
Lithopone	,,	57	10	0
Magnesite, Calcined	,,	20	0	0
,, Raw	,,	13	0	0
Magnesium Chloride	,,	20	0	0
,, Sulphate, Comml.	,,	15	10	0
Methylated Spirit, Industrial, 66 O.P.	per gal.		5	10½
Nickel Sulphate	per ton	207	0	0
Nitric Acid, 70° Tw.	,,	35	0	0
Oxalic Acid	,,	132	0	0
Phosphoric Acid (S.G. 1·750)	per lb.		1	4
Potassium Bichromate	per ton	131	16	8
,, Bromide	per lb.		2	6
,, Carbonate (hydrated)	per ton	72	10	0
,, Chloride	,,	21	0	0
,, Iodide	per kilo		19	3
,, Hydrate (Caustic) flake	per ton	92	0	0
,, Nitrate	per cwt.	3	10	0
,, Permanganate	,,	10	3	0
,, Sulphate, 50%	per ton	22	0	6
Sodium Acetate	,,	63	0	0
,, Arsenate, 58–60%	,,	Nominal		
,, Bicarbonate	,,	18	0	0
,, Bichromate	,,	109	13	4
,, Carbonate (Soda Ash) 58%	,,	16	0	6
,, Chlorate	per ton	90	0	0
,, Cyanide	per cwt.	6	18	10
,, Hydrate, 98/99%, solid	per ton	35	6	6
,, Hyposulphite, Comml.	,,	35	0	0
,, Nitrate, Comml.	,,	Nominal		
,, Phosphate (Dibasic)	,,	40	10	0
,, Prussiate	per lb.		1	0½
,, Silicate	per ton	16	0	0
,, Sulphate (Glauber's Salt)	,,	12	5	0
,, ,, (Salt-Cake)	,,	10	0	0
,, Sulphide, flakes, 60/62%	,,	40	12	6
,, Sulphite, Comml.	,,	27	15	0
Sulphur, American, Rock (Truckload)	,,	13	0	0
,, Ground, Crude	,,	17	10	0
Sulphuric Acid, 168° Tw.	,,	12	0	0
,, ,, free from Arsenic, 140° Tw.	,,	8	10	0
Superphosphate of Lime, 18% P_2O_5	,,	13	10	0
Tin Oxide	,,	Nominal		
Titanium Oxide, Rutile	,,	172	0	0
,, White, 25%	,,	85	0	0
Zinc Chloride	,,	95	0	0
,, Dust, 95/97% (4-ton lots)	,,	112	0	0
,, Oxide	,,	85	0	0
,, Sulphate	,,	32	0	0

Share Quotations

Shares of £1 par value except where otherwise stated.

GOLD AND SILVER:	Nov. 6, 1961 £ s. d.	Dec. 5, 1961 £ s. d.
SOUTH AFRICA:		
Blinkpoort (5s.)	2 8 9	2 11 6
Blyvooruitzicht (2s. 6d.)	1 6 9	1 6 3
Bracken (10s.)	19 0	1 1 3
Brakpan (3d.)	4 0	5 3
Buffelsfontein (10s.)	1 13 6	1 15 6
City Deep	12 9	14 6
Consolidated Main Reef	12 3	12 6
Crown Mines (10s.)	18 3	18 6
Daggafontein (5s.)	17 6	17 6
Dominion Reefs (5s.)	1 0 3	1 0 9
Doornfontein (10s.)	1 7 6	1 9 3
Durban Roodepoort Deep (10s.)	1 5 6	1 7 6
East Champ d'Or (2s. 6d.)	1 6	1 6
East Daggafontein (10s.)	9 3	9 6
East Geduld (4s.)	14 0	15 3
East Rand Ext. (5s.)	16 3	17 3
East Rand Proprietary (10s.)	1 4 9	1 7 3
Freddies Consol.	1 9	2 0
Free State Dev. (5s.)	4 3	4 0
Free State Geduld (5s.)	4 15 0	4 19 3
Free State Saaiplaas (10s.)	3 6	3 6
Geduld	2 4 6	2 11 6
Government Gold Mining Areas (3d.)	1 6	2 0
Grootvlei (5s.)	16 0	17 3
Harmony (5s.)	1 1 9	1 1 3
Hartebeestfontein (10s.)	2 4 3	2 10 0
Libanon (10s.)	14 6	15 3
Loraine (10s.)	19 6	18 0
Luipaards Vlei (2s.)	8 3	9 0
Marievale (10s.)	1 5 3	1 6 3
Modderfontein B (3d.)	1 3	1 6
Modderfontein East	7 3	8 6
New Kleinfontein	4 9	4 9
New Pioneer (5s.)	1 8 3	1 10 0
New State Areas (15s. 6d.)	6	6
President Brand (5s.)	2 10 3	2 14 9
President Steyn (5s.)	13 6	14 6
Rand Leases (9s. 3d.)	4 6	4 3
Randfontein	19 6	18 9
Rietfontein (3d.)	2 0	2 0
Robinson Deep (3d.)	3 9	4 3
Rose Deep (3d.)	5 6	5 9
St. Helena (10s.)	3 5 0	3 10 0
Simmer and Jack (1s. 6d.)	1 3	1 6
South African Land (3s. 6d.)	14 3	15 3
Springs (3d.)	1 6	1 3
Stilfontein (5s.)	1 8 6	1 9 6
Sub Nigel (3d.)	7 0	7 3
Vaal Reefs (5s.)	1 19 6	2 3 0
Van Dyk (3d.)	1 9	2 0
Venterspost (10s.)	1 1 0	1 3 0
Virginia (5s.)	2 3	2 6
Vlakfontein (10s.)	15 0	16 0
Vogelstruisbult (3d.)	4 6	4 6
Welkom (5s.)	14 0	14 3
West Driefontein (10s.)	4 2 6	4 7 6
West Rand Consolidated (10s.)	17 3	17 0
West Witwatersrand Areas (2s. 6d.)	2 12 6	2 17 6
Western Holdings (5s.)	5 16 3	6 9 3
Western Reefs (5s.)	1 5 6	1 7 9
Winkelhaak (10s.)	18 9	1 0 6
Witwatersrand Nigel (2s. 6d.)	6	6
Zandpan (10s.)	6 6	6 9
RHODESIA:		
Cam and Motor (2s. 6d.)	—	—
Chicago-Gaika (10s.)	12 6	12 6
Coronation (2s. 6d.)	3 6	3 6
Falcon (5s.)	10 0	10 9
Globe and Phœnix (5s.)	1 9 6	1 11 3
Motapa (5s.)	—	—
GHANA:		
Amalgamated Banket (3s.)	—	—
Ariston Gold (3s. 6d.)	—	—
Ashanti Goldfields (4s.)	9 9	9 6
Bibiani (4s.)	—	—
Bremang Gold Dredging (5s.)	—	—
Ghana Main Reef (5s.)	—	—
Konongo (2s.)	9	9
Kwahu (2s.)	3 0	3 0
Offin River (2s. 6d.)	1 6	1 3
Western Selection (5s.)	3 6	3 6
AUSTRALASIA:		
Gold Fields Aust. Dev. (3s.), W.A.	1 9	2 3
Gold Mines of Kalgoorlie (10s.)	7 9	7 9
Great Boulder Propriet'y (2s.), W.A.	11 9	12 3
Lake View and Star (4s.), W.A.	1 2 6	1 4 0
Mount Morgan (10s.), Q.	12 3	11 3
New Guinea Gold (4s. 3d.)	1 6	1 3
North Kalgurli (1912) (2s.), W.A.	9 3	9 9
Sons of Gwalia (10s.), W.A.	2 3	2 3
Western Mining (5s.), W.A.	16 9	16 3

	Nov. 6, 1961 £ s. d.	Dec. 5, 1961 £ s. d.
MISCELLANEOUS:		
Fresnillo ($1·00)	1 18 9	2 6 3
Kentan Gold Areas	13 9	13 0
St. John d'el Rey, Brazil	4 12 6	3 12 6
Yukon Consolidated ($1)	3 3	3 3
COPPER:		
Bancroft Mines (5s.), N. Rhodesia	10 3	9 9
Esperanza (2s. 6d.), Cyprus	2 4½	2 3
Indian (2s.)	5 0	5 3
MTD (Mangula) (5s.)	6 9	5 9
Messina (5s.), Transvaal	13 3	12 0
Mount Lyell (5s.), Tasmania	6 3	6 0
Nchanga Consolidated, N. Rhodesia	2 5 3	2 6 6
Rhokana Corporation, N. Rhodesia	2 2 6	2 3 9
Roan Antelope (5s.), N. Rhodesia	4 0	4 6
Tanganyika Concessions (10s.)	18 6	16 0
LEAD-ZINC:		
Broken Hill South (1s.), N.S.W.	9 9	9 9
Burma Mines (3s. 6d.)	1 3	1 6
Consol. Zinc Corp. Ord.	2 19 3	2 6 3
Lake George (5s.), N.S.W.	3 3	3 3
Mount Isa, Queensland (5s. Aust.)	2 14 6	2 14 3
New Broken Hill (5s.), N.S.W.	2 1 3	1 19 0
North Broken Hill (10s.), N.S.W.	13 3	14 6
Rhodesia Broken Hill (5s.)	7 0	7 0
San Francisco (10s.), Mexico	18 6	19 0
TIN:		
Amalgamated Tin (5s.), Nigeria	10 0	9 3
Ampat (4s.), Malaya	16 3	13 6
Ayer Hitam (5s.), Malaya	2 6 0	2 4 0
Beralt (5s.), Portugal	1 3 0	1 0 6
Bisichi (2s. 6d.), Nigeria	4 6	4 6
Ex-Lands (2s.), Nigeria	3 9	3 9
Geevor (5s.), Cornwall	1 6 3	1 5 0
Gold Base Metals (2s. 6d.), Nigeria	1 9	1 9
Hongkong (5s.), Malaya	1 3 0	1 2 0
Jantar Nigeria (3s.)	5 6	5 3
Kaduna Syndicate (2s.), Nigeria	2 9	2 10½
Kamunting (5s.), Malaya	19 0	15 0
Malayan Tin Dredging (5s.)	1 10 0	1 9 0
Mawchi Mines (4s.), Burma	1 6	1 9
Naraguta Karama (5s.), Nigeria	1 0	1 2
Pahang (5s.), Malaya	16 6	16 6
Siamese Synd. (5s.)	19 0	18 0
South Crofty (5s.), Cornwall	7 6	7 3
Southern Kinta (2s.), Malaya	1 3 0	1 2 6
Southern Malayan (5s.)	1 15 0	1 8 6
Sungei Besi (4s.), Malaya	2 4 0	2 5 0
Sungei Kinta, Malaya	12 0	12 0
Sungei Way (2s. 4d.), Malaya	5 6	5 9
Temoh (7s. 6d.), Malaya	3 6	3 6
Tronoh (5s.), Malaya	1 10 6	1 8 0
United Tin Areas (2s. 6d.), Nigeria	1 4½	1 6
DIAMONDS:		
Anglo American Investment	13 10 0	13 15 0
Consol African Selection Trust (5s.)	15 9	16 0
Consolidated of S.W.A. Pref. (10s.)	7 9	8 3
De Beers Deferred (5s.)	7 0 0	7 8 9
FINANCE, ETC.		
African & European (10s.)	2 5 0	2 13 9
Anglo. American Corporation (10s.)	6 17 6	7 2 6
Anglo Transvaal 'A' (5s.)	1 9 0	1 11 9
British South Africa (15s.)	2 19 9	2 19 9
British Tin Investment (5s.)	17 6	17 9
Broken Hill Proprietary	2 15 0	2 14 3
Camp Bird (10s.)	5 0	4 3
Central Mining	1 16 3	1 19 6
Central Provinces Manganese (10s.)	14 3	17 9
Consolidated Gold Fields	3 0 3	3 9 0
Consolidated Mines Selection (10s.)	1 8 3	1 11 3
Corner House	11 6	13 3
East Rand Consolidated (5s.)	1 9	1 9
Free State Development (5s.)	4 3	4 0
General Exploration O.F.S. (2s. 6d.)	3 3	3 3
General Mining and Finance	4 7 6	4 15 3
Hendersons (4s.)	8 3	9 6
Johannesburg Consolidated	2 5 9	2 14 3
London & Rhod. M. & L. (5s.)	8 9	9 0
London Tin Corporation (4s.)	15 6	15 3
Lydenburg Est. (5s.)	—	—
Marsman Investments (10s.)	2 7½	2 7½
National Mining	1 9	1 9
Rand Mines (5s.)	2 15 9	3 2 6
Rand Selection (5s.)	2 2 0	2 5 9
Rhodesian Anglo American (10s.)	2 14 6	2 16 3
Rhodesian Corporation (5s.)	1 9	2 0
Rhodesian Selection Trust (5s.)	8 3	8 3
Rio Tinto (10s.)	2 0 0	2 1 3
Selection Trust (10s.)	4 7 6	4 15 3
South West Africa Co. (3s. 4d.)	8 9	8 6
Union Corporation (2s. 6d.)	2 13 6	3 2 0
Vereeniging	5 3 3	5 15 0
West Rand Inv. Trust (10s.)	2 6 9	2 11 6

THE MINING DIGEST

A RECORD OF PROGRESS IN MINING, METALLURGY, AND GEOLOGY

In this section abstracts of important articles and papers appearing in technical journals and proceedings of societies are given, together with brief records of other articles and papers; also notices of new books and pamphlets and lists of patents on mining and metallurgical subjects.

Flow-Sheet for Mineral Sands

An article in the Indian *Journal of Mines, Metals, and Fuels*, for August last by P. Viswanathan, describes an "Improved Flow-sheet for Concentration of Minerals from Chavara Beach Sands." The author says that a standardized procedure for concentrating ilmenite, monazite, zircon, rutile, and sillimanite has been indicated. It is evolved for the simultaneous production of all the minerals mentioned in a continuous operation and recovering the economic minerals to the maximum extent possible. At present not more than 80% of the ilmenite present in the feeds is being recovered, while the production of monazite is confined to the requirements of the processing plant of Indian Rare Earths, Alway, and the export of this mineral is totally banned. The production of rutile and zircon is of the order of hundreds of tons, forming but a negligible fraction of the total quantity of these minerals present in the feeds. No sillimanite at all is produced. There has not developed any commercial market for leucoxene as yet, but the high titanium content of this mineral should find some opening sometime or other. "At a very modest estimate, about 2,500 tons of raw materials are consumed every day in the four concentrating plants. From this basic feed only about 1,500 tons of ilmenite are recovered. The balance is trucked off to the beach and the tailings contain at least 200 tons of ilmenite unrecovered, 150 tons each of zircon and rutile, and about 100 tons of willimanite. Computing 300 working days in the year if all the minerals are recovered there would result an increased production of 60,000 tons of ilmenite, 45,000 tons of zircon and rutile each, and 30,000 tons of sillimanite."

The market for Indian ilmenite is becoming increasingly tight, due to increasing competition. The best means of retaining the world market is by keeping down cost of production and at the same time maintaining a regular rate of production at high quality. The excessive freight element in the cost structure of Indian ilmenite can be mitigated only by lower prices. The only way of accomplishing this is by increasing productivity and the extraction of all the by-product minerals.

The average percentage composition of the sand deposits mined and used as feed to the concentrating plants is as follows :—Ilmenite, 60 to 80; zircon, 5 to 7; rutile, 4 to 6; sillimanite, 3 to 4; monazite, $\frac{1}{4}$ to 2, and garnet, $\frac{1}{4}$ to $\frac{1}{2}$, the rest mostly quartz. The content of garnet in the sands is sufficiently low as not to cause technical difficulties in the magnetic concentration of ilmenite, because garnet is also magnetic and tends to concentrate with ilmenite. This is a patent difficulty in the Manavalakurichi sands, where an additional gravity concentration is essential for eliminating the garnet. This additional operation naturally adds to cost of production.

The chief factors which affect the present methods of concentration need careful examination. The magnetic concentration of ilmenite is complicated by two important factors. The first is that the ilmenite is not of uniform magnetic attractability, which varies over a wide range depending upon its chemical composition. Ilmenite richer in titanium is characterized by lower magnetic attractability. The magnetic attractability of some ilmenite grains overlaps the magnetic property of monazite. Secondly, the grain size of ilmenite too varies over a wide range. In the first or primary magnetic concentration nearly 50% of the ilmenite present in the feeds is lifted off in cross-belt separators at almost 98% purity. It is in effective recovery of the residual ilmenite that changes are called for. The deployment of higher-intensity magnetic fields to scavenge the ilmenite results in the concentrated ilmenite being contaminated with non-magnetic impurities like zircon, rutile, and sillimanite which are physically entrained. If the monazite content in the ilmenite exceeds 0·12% it becomes unfit for export.

The improved flow-sheet incorporates three

stages in the concentration of ilmenite. The first is on lift magnetic separators; the second is carried out also in lift separators, but after boosting the ilmenite on wet tables and removing the rutile on light-intensity induced-roll deflect-type magnetic separators. The wet tabling operation helps to separate almost all the monazite as a heavy cut away from all ilmenite. The finest grains of ilmenite which tend to concentrate with the heavy monazite is recovered by concentration on electrostatic separators making use of the conducting property of ilmenite as against the non-conducting nature of monazite.

The middling concentrates from the wet tables provide a very rich zircon–rutile mixture free from both sillimanite and quartz which affect electrostatic concentration seriously. The wet tabling serves also another useful purpose of washing out the salt coating on the sands. During the hot summer months a thick coating of salt over the sands makes the separation of rutile from zircon in the electrostatic separators difficult because the salt coating makes even the non-conductive minerals conductive.

The third and the lightest cut from the wet tables contain almost all the sillimanite, together with all the quartz. The sillimanite can be concentrated in froth-flotation cells to a purity of over 80% and later treated on dry gravity tables and high-intensity induced-roll magnetic separators to free it from traces of rutile and zircon to a final concentrate of 99 + purity.

The successful working of the improved flow-sheet will depend upon the incorporation of an efficient dry gravity table. The entire operation has necessarily to be mechanized, reducing the human element to a minimum. Maximum productivity can be attained only by this means. It looks quite evident that unless the present static and outmoded methods are improved and new life put into the operations—and that without much loss of time—the fate of the industry may become problematical with the result that the precious assets which nature has endowed to the nation may go unutilized.

Minerals from Hong Kong

The notes reproduced here are taken from the *Hong Kong Trade Bulletin* for July, where they are part of an article entitled "Hong Kong's Mineral Deposits." It is recorded that argentiferous galena, wolframite, molybdenite, garnet, pyrite, mica, magnetite, hematite, cassiterite, sphalerite, graphite, kaolinite, feldspar, topaz, beryl, fluorspar, quartz, and gold, all exist in varying quantities in the rocks of Hong Kong. There is archaeological evidence that some 3,000 years ago men worked the local quartzites and clays to fashion simple vessels. It was not until the 19th Century, however, that metallic minerals were first exploited, when Portuguese and Chinese companies began to mine for lead and silver. As a result of these enterprises several Portuguese names survive among the families of the New Territories, while others are still used for geological landmarks throughout the Colony. To-day Hong Kong is one of the most congested areas in the world. The expanding needs of industrial developments, housing, roads, reservoirs, and agriculture, all make increasing demands on the little land available. Even so it continues to prove an economic proposition to mine iron ore, graphite, wolframite, kaolin, quartz, and feldspar, in some rural areas. In 1960 exports of these minerals were valued at HK$6,126,695.

The most important of the Colony's mineral deposits is iron ore, which is mined by a local company almost entirely from underground sources, and contains an average Fe content of 32%. This is concentrated up to 56% Fe in a plant employing wet magnetic separation; the plant is capable of treating 700 tons of crude ore a day. Production in 1960 was 117,042·56 long tons valued at $5,272,770. During the past few years diamond drilling has been used to ascertain the extent and value of the deposit. It is now intended to plan future development below the existing 240-m and 280-m. levels. Reserves of iron ore are estimated at 10,000,000 tons and planned production is 120,000 tons of concentrate a year.

Wolframite was first discovered in China in 1914. The bulk of the Colony's production of wolframite goes at present to the U.S. In 1960 production was 31·21 tons of concentrate containing 65% WO_3 valued at HK$246,246. This was produced from 11,165 tons of crude ore by hand cobbing, crushing, screening, and sluicing.

Graphite, variable in carbon content, is found as a seam in sedimentary rocks on the small West Brother Island to the west of Hong Kong. Only grades with a fixed carbon content exceeding 75% have so far been exported; this has been in lump form after hand selection.

Ma On Shan Mine, New Territories.

Markets for the best grades of Hong Kong graphite are Canada, U.S.A., Japan, Thailand, United Kingdom, India, and Formosa ; in 1960 total exports were valued at approximately HK$200,000. Low-grade graphite of 50% fixed carbon or less is sold for use as fuel in the Colony's brick factories.

Kaolin occurs in many places in the Colony and at present about 5,600 tons are mined every year from an area near the water-front at Cha Kwo Ling. As soon as the kaolin is extracted from the ground it is sorted into several grades which are separately dried and stored. Selected clays are washed in tanks to reduce the silicon and feldspar content so as to produce a special highly plastic kaolin rich in alumina. The bulk of the production from Cha Kwo Ling, however, is sold immediately after drying and blending—though in all cases close attention is paid to the relative proportions of alumina, silica, and iron oxide present in the clay. The bulk of Hong Kong kaolin is exported to Japan (in 1960 6,282·35 long tons worth HK$779,589) ; the remainder is sold to the local ceramic, brick, rubber and, strangely enough, cosmetic companies.

There is a limited export trade worth about HK$20,000 a year in quartz and feldspar with Pakistan, Formosa, Thailand, and the Sudan, but in general production depends on the demands of the local glass, ceramic, and enamelware industries. The low market value of these minerals renders production uneconomic as soon as workings have reached a depth at which large quantities of overburden have to be removed in order to ensure safe working conditions.

The power to grant prospecting and mining licences is vested in the Commissioner of Mines (at present concurrently the Commissioner of Labour). Prospecting licences are granted for periods of six months renewable up to five years ; mining licences are granted for periods of six months, renewable up to five years. Mining leases may be granted up to 21 years by the Registrar General in his capacity as Land Officer.

Royalties of 5% of the value of all minerals won by a licensee or lessee are payable to Government.

Concrete Headframes in South Africa

In *Mining Engineering* for November A. C. Backeberg reviews the "Design of Concrete Headframes for South African Gold Mines" and the following notes are abstracted from his article. The author points out that there is no South African code for the design of reinforced-concrete headframes and all those erected have been designed on a uniform basis. With certain exceptions designs have generally conformed with British Standard Code of Practice C.P. 114.

In the design of these headframes the following loads are taken into account :—

Dead Load.—These loads include the weight of the sheaves, platforms, beams and bearings, the internal steelwork, which is supported by the shell, and weight of the structure itself.

Rope Loads.—For normal conditions rope loads are taken as equal to the weight of the rope itself together with the weight of a fully-loaded or an empty conveyance. For extreme conditions, corresponding to an over-wind in which the safety devices fail to operate, the force in a rope is assumed to be equal to its static breaking load.

Live Loads.—These loads include the weight of rock in any ore bins which are incorporated in the structure, the reactions of conveyors supported by the headgear, and the superimposed loading on the various working platforms.

Wind Loads.—These loads are usually based on a wind velocity of about 70 m.p.h.

Two basic conditions of loading are considered. The first, which corresponds to the worst loading likely to occur under normal operating conditions, is the most adverse combination in the various loads. It is usual, the author says, to specify that the stresses due to loading must not exceed the normal permissible stresses given in C.P. 114, except that the 25% increase for the combined effects of wind and other loadings is not usually permitted. The second condition, which represents the worst that is likely to happen in an overwind, is the most adverse combination of dead load ; breaking load of any one rope, normal rope loads in all remaining ropes, live loads, and wind loads. For this combination of loads it is usual to specify that the stresses may exceed the normal permissible stresses given in C.P.114 by 25%, provided the tensile stress in the reinforcement does not exceed 30,000 p.s.i.

Where reinforced-concrete headframes are used for shaft sinking as well as for normal operation the loading conditions corresponding to both sinking and normal operation must be investigated. The combination of loading corresponding to overwind conditions usually governs the design of a reinforced concrete headgear. Stresses due to ordinary-operating loads, at least at critical sections, are checked by inspecting for tension in the concrete of the sheli under the ordinary conditions of normal service.

Margaret Shaft

When this headframe for a six-compartment rectangular shaft was being planned, says the author, structural steel was in such short supply that fabrication in steel had to be ruled out.

The loading conditions were given by the following data : Height to sheaves—126½ ft. ; number of compartments—six ; number and diameter of sheaves —six, 18-ft. diam. ; hoisting ropes—2-in. diam., 200 tons breaking load ; hoist load—610-ton skips at 5,000 ft. depth ; rock reception—ore bin and waste bins to be provided ; grouping of hoists—together. In order to enable shaft sinking to commence and to continue while the construction proceeded the design was required to make provisions for the support of six 8-ft. diam. temporary sinking sheaves at an elevation of about 48 ft. above collar level.

The structure consists essentially of a rigid platform carrying the main sheaves at 126½-ft. elevation supported by six legs, which are framed together horizontally immediately below an elevation of 47¾ ft., where support is provided for the temporary sinking sheaves, as required. The legs are T-shaped in cross section.

The most adverse of the conditions of loading were taken for the design of the headgear—*viz.*, one rope loaded to breaking point and the remaining ropes at normal full load simultaneously. To this load condition there was added an allowance of 20% for the effect of the actual breaking of the first rope and 60% was added to each of the other ropes to provide for loads due to acceleration. Provision was also made for an upward thrust to deal with the kinetic energy to be absorbed in the event of an overwind and cushioning devices were incorporated in the headframe for this purpose. The design was based on the following working stresses : Concrete in beams—400 p.s.i. ; main legs—625 p.s.i. ; incline legs—750 p.s.i. ; shear —150 p.s.i. ; steel in tension—11,750 p.s.i. ; compression—11,250 p.s.i.

Extraordinary care was exercised in maintaining the concrete mix to the design requirements. Crushed dolerite was used, graded in a screening plant established on the site so as to ensure consistency of grading. The precaution was taken to dredge and stockpile the whole of the sand requirements from the Vaal River in a short space of time at the beginning of the contract so as to avoid the effects of seasonal change in sand grading. All concrete was vibrated, the mix being designed so that overvibration could not arise. The legs were poured in 6-ft. lifts to the haunches of the beams; at this point the pour was monolithic, comprising a portion of the side and centre beams and the stub of the leg. Concrete was cured by wrapping coconut matting around the members and keeping it constantly wet. Cube tests gave results varying from 4,500 to *plus* 6,400 p.s.i., the average being 6,000 p.s.i. after seven days. Cube moulds were vibrated with an external vibrator so that the results obtained gave a close approximation to the actual placing conditions on the site. The lower portion of the headframe was completed within three months, after which the temporary sheaves were erected and concreting of the remainder of the structure proceeded.

Riebeek Shaft

When this shaft was sited it was foreseen that there would be no escaping the problem of poor foundation conditions for a headframe. The placing of foundations for a steel headframe was complicated by the measures necessary to counteract periodical and changeable differential vertical movements through subsidence or heaving of individual foundations. The shaft was to have a 26-ft. diam. and 5,745-ft. hoisting depth. It was also to be divided with a brattice wall for ventilation requirements. Two large a.c. double-drum hoists were available and they were to be situated on opposite sides of the shaft. These hoists are of 4,400 h.p. at a speed of 3,000 f.p.m. and are fitted with $1\frac{7}{8}$-in. diam. ropes having a 175-ton breaking load that are capable of hoisting 8-ton skips or man cages for 90 men. Provision was to be made in the design of headframe for a third large hoist which could be a tower Koepe hoist, or, alternatively, a ground drum hoist fitted with ropes of $2\frac{1}{8}$-in. diam. and 230-ton breaking load.

The decision was taken to construct a circular reinforced-concrete headframe 150 ft. high, 35 ft. internal diam., and 18-in. wall thickness. It was also decided to sink the foundation to a depth of 60 ft. A caisson having a 3-ft. thick wall was sunk accordingly and toed in at the bottom by spreading the width of the lining to a footing approximately 10 ft. wide. When this caisson was completed the lining was cast to a 30-ft. thickness by the normal hand-over-hand method for a further 38 ft. of depth. This portion of the lining was reinforced, but below this point normal 12-in. thick unreinforced-concrete shaft lining was used.

This structure depended for its stability partly on lateral passive pressures in the foundation in the direction of the maximum resultant pull of the winder ropes and partly on the eccentricity of foundation bearing pressure on a widened footing on the bottom of the 38-ft. O.D. cylinder. In calculating the passive pressure support the contribution of material above the water table, which lay at 20 ft. depth, was neglected.

The task of sinking the caisson was carried out in the accepted manner for successive lifts and, except for the extreme care necessary to maintain vertically by judicious control of the removal of spoil around the cutting edge, the procedure calls for no special comment.

The construction of the superstructure of the headframe was completed by the sliding shutter method.

Trade Paragraphs

Johnson, Matthey and Co., Ltd., of 73–83, Hatton Garden, London, E.C. 1, have acquired the majority of the shares of the leading Belgian precious metal company, Pauwels Frères S.A. This Belgian company, established in 1864, has a long history of friendly relations with Johnson, Matthey and for over 30 years has acted as their principal agency in Belgium.

William Jessop and Sons, Ltd., and **J. J. Saville and Co., Ltd.,** of Sheffield, last month showed a film in London designed to explain first the many applications of tool steels and then the sequence of manufacture of tool and die steels, leading up to the transformation of blocks of steel into intricate dies and moulds used in other industries, such as die casting and plastic moulding.

Ruston and Hornsby, Ltd., of Lincoln, state that new office accommodation to house the whole of the Ruston Group's London staff has been acquired in Berkeley Square House, Mayfair, W. 1. This includes their associate company **Davey, Paxman and Co., Ltd.**

At the same time **Ruston-Bucyrus, Ltd.,** excavator specialists, wish to emphasize that their London Office is retained at Crompton House, 95, Aldwych, W.C. 2.

Sturtevant Engineering Co., Ltd., of Southern House, Cannon Street, London, E.C. 4, call attention to high-efficiency collectors and vacuum valves manufactured by an associate company—Mancuna Engineering, Ltd., of Denton, Manchester. The dust collector is a multi-cyclone unit designed to prevent air pollution but also to recover saleable fines. The valve provides an air-tight seal for the discharge end of hoppers or bins or any type of dust collector operating under negative pressure.

Turner and Newall, Ltd., of Asbestos House, 77–79, Fountain Street, Manchester, 2, announce that a new company, Hardie-Ferodo Pty., Ltd., will shortly be formed in Australia to manufacture and market brake linings, clutch facings, and other friction materials for the automotive and general industrial field. The new company is being created by a merger of the Australian Ferodo interests of Turner and Newall, Ltd., and the brake lining division of James Hardie and Co. Pty., Ltd., of Sydney, the makers of Hardibestos linings.

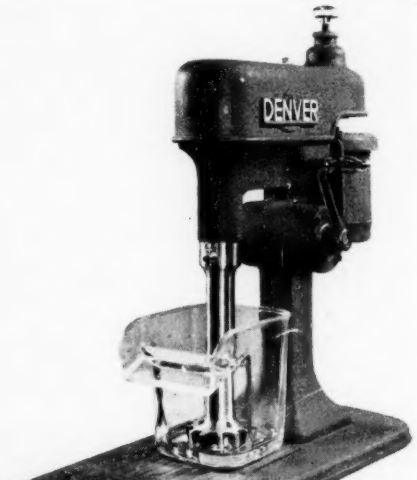
Towler Sales, Ltd., of 10 Bardon Chambers, Infirmary Street, Leeds, have been appointed sole world selling agents for the industrial application of Gleniffer diesel engines. Up to the present time the majority of applications have been for marine propulsion duties. It is now intended that the industrial market should be given more vigorous attention, particularly in the fields of electrical generation, pumping, and drilling rigs. The engine is eminently suitable for continuous duty and admirable for working in remote areas.

W. and T. Avery, Ltd., of Birmingham, issue an illustrated booklet which describes a new range of predetermined weight feeders for a considerable variety of requirements. Totalized weight is shown on a 7-figure counter fitted within the indicator chart. Weight to be delivered is set on a counter at the machine or at a remote point.

Another booklet covers a new range of totalizing belt weighers adapted to meet a number of requirements and the machines are designed to fit into an existing conveyor system either horizontal or inclined.

Cementation Group of Companies, of 20, Albert Embankment, London, S.E. 1, draw attention to the use of compaction for unstable ground. Particularly unstable ground conditions posed such problems in Middlesbrough, where a liquid oxygen plant is under construction. The site consists of extremely loose ash and sand, some 15 ft. deep, with firm marl below. Instead of relying on a reinforced concrete raft or on piles, the loose soil is being compacted to 80% relative density by the company's vibroflotation process. After compaction the load-bearing capacity will be 3 tons per sq. ft. Apart from supporting the column bases of the plant's structure, the foundations will take the direct weight and vibration of heavy compressors, motors, and generators.

Denver Equipment Co., of Denver, Colorado (London office: 15–17, Christopher Street, E.C. 2), have introduced a new laboratory flotation cell, which embodies many new advances—such as, a stainless-steel suspended-type mechanism, glass tank, positive speed control, aeration adjustment, and a safety-mechanism lifting device. So that laboratories



may take advantage of the progress made in flotation during the past 50 years the company is making a $100·00 trade-in allowance for laboratory flotation machines regardless of make, model, or age towards the purchase of a new Model D-1 (for batch tests of 250 g., 500 g., or 1,000 g.) or the Model D-2 (for 2,000-g. tests), which is open until December 31 next. The new model D-1 is illustrated.

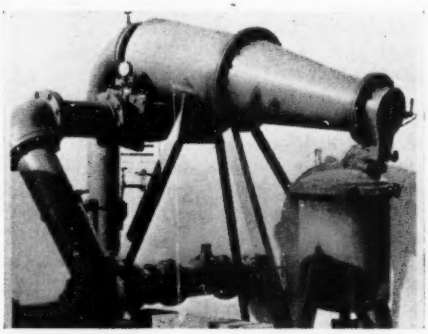
Caterpillar Tractor Co., Ltd., P.O. Box No. 162, Glasgow, announce that the 944A wheel Traxcavator is now in production at the Glasgow plant. This 2 cu. yd. machine is shown in the

illustration and is the second largest of the new wheel loaders introduced by Caterpillar in the United States last year. There is 2 ft. 7 in. reach at the maximum dumping height of 9 ft. 1 in. Automatic bucket positioner and lift kickout, both hydraulically operated, are standard equipment. The rack-back of the bucket at ground level is 41°. The 944A has a 105-h.p. Caterpillar diesel engine (maximum rating 135 h.p.). The transmission is geared to give reverse speeds 25% faster than forward speeds, top speed being 30 m.p.h.

Padley and Venables, Ltd., of Dronfield, Sheffield, have entered into a conditional agreement to purchase the whole of the issued share capital of **Production Tool Alloy Co., Ltd.**—one of the leading companies in the hard metal industry who have for some years been the sole suppliers of tungsten carbide tips to Padley and Venables, Ltd., for incorporation in their production of rotary and percussive drilling bits and coal cutter picks. This purchase is, therefore, felt to be a sound and natural development of the close co-operation which has existed for some time and should strengthen the position of Padley and Venables in an industry and market which should continue to develop. It is also proposed to form individual operating companies to conduct separately the two businesses at Dronfield, Sheffield (mining and engineering) and Aldridge, Staffs. (stainless steel).

Neldco Processes, Ltd., of Crossway House, Bracknell, Berks., announce that they have arranged for the manufacture by **G. Q. Parachutes, Ltd.,** of a new type of overall harness designed for use with the Sala safety block but equally suitable for use with any other type of safety line. This equipment eliminates all the inconvenience of normal harnesses while maintaining full security and increasing the comfort of the user, it is stated.

In another note they refer to the Krebs centrifugal sand separator, now available in England for the first time and which is a device for removing fine sand, scale, and similar materials from water. It replaces conventional sand traps with substantial savings in capital and maintenance costs, efficiency of removal of solids being often better than 97%. As can be seen in the illustration the separator is a



centrifugal device and it uses energy supplied by the main circuit pumps. It has no moving parts. Standard sizes have capacities from 50 g.p.m. to 1,600 g.p.m. and larger sizes can be built to order.

The George Cohen 600 Group, Ltd., of Wood Lane, London, W. 12, announce that a complete modern mineral treatment plant, installed at the Avonmouth works of the National Smelting Co., Ltd., has been acquired for resale by George Cohen, Sons and Co., Ltd. The plant comprises a materials handling system followed by jaw, Kennedy, gyratory, and rolls crushing equipment of large capacity, with materials storage and feeding plant to four rotary kilns by Ernest Newell. Two of these are 160 ft. long by 11 ft. 3 in. diam. and the remaining two are 135 ft. by 8 ft. 2 in. and 80 ft. by 6 in., respectively. They are designed for pulverized-coal firing. The residues from the principal kilns pass through conveyors to storage bunkers. Metallic fume from the kilns is collected in a very large automatically-shaken bag plant, by Power Gas Corporation, comprising five separate units contained in a building, each unit capable of handling 25,000 c.f.m., together with the

Atlas Lighting in Salt Mine

entire dust collecting and removing equipment. The handling plant comprising belt-conveyors, screw conveyors, elevators, etc., was supplied by Spencers, Melksham, Ltd.

Atlas Lighting, Ltd., of Thorn House, Upper St. Martin's Lane, London, W.C. 1, have issued a note on an installation at the Meadow Bank salt mine of Imperial Chemical Industries, Ltd., Winsford, Cheshire, 400 ft. below ground level. Here caverns 20 ft. high are hewn out of the salt and glittering pillars of rock salt provide local support for the roof. Atlas "Atlantic" single 8-ft. batten fittings, with anti-corrosive paint finish and starter switch control gear, have been installed to light these caverns and roadways and reflector-type white fluorescent tubes are used throughout, thereby obviating the use of metal reflectors with their associated maintenance problems. Illumination level obtained is approximately 8–9 lumens per sq. ft. (see illustration).

The installation was planned by the Engineering Department of Imperial Chemical Industries, Ltd., in association with the Lighting Engineering Department of Atlas Lighting, Ltd.

Griffin and George, Ltd., of Ealing Road, Alperton, Middx., have produced a new set of analytical weights of interest to both educational authorities and industrial laboratories. The weights are of brass, finished tin-nickel plate and polished, and are of two-piece construction. Tests carried out at the National Physical Laboratory have shown that the tin-nickel alloy finish has no undesirable magnetic properties and is resistant to corrosion by alkalis, nitric acid, and other acids at normal temperatures. The sets are supplied in plastic cases with moulded blocks of polythene to hold the unit weights. They have also added to their range of laboratory stirrers the new Griffin-Citenco stirring motors, described in a leaflet. This motor is of particular use in the preparation of chemicals involving the use of liquids with high viscosity, since it has variable speed adjustment and also the ability to produce high torque at low speeds through a reduction gearbox.

Craven Electronics, Ltd., of Victoria Works, Bingley, Yorks., announce the introduction of new flameproof temperature and level control equipment consisting of two units, a probe with a flameproof terminal chamber which is fitted into the hydraulic reservoir, and the control unit which is also flameproof and may be remotely mounted. Both temperature and level are sensed by similar detectors housed in the probe tip. These are temperature-sensitive resistors connected in a.c. bridge networks. For the temperature control arrangement the bridge is arranged to be exactly in balance at the trip temperature level. The bridge output signal is then alternating voltage which, when the temperature is below the trip point, is in phase with the bridge energizing supply and 180° out of phase above the trip point. A transistor circuit detects the phase change, which is an instantaneous reversal at the trip point and causes a relay to become de-energized.

The level detector is similar except that the sensing resistor has a small heater winding

incorporated. Providing that the liquid level is above the tip of the probe any heat generated by the heater winding is dissipated in the tank contents. This holds good for temperatures in excess of the temperature trip setting. If the liquid level falls to expose the tip of the probe the heater coil now causes the sensing resistor to heat rapidly which in turn creates conditions exactly as for the temperature sensing unit.

Fairbanks Whitney Corporation, of 745 Fifth Avenue, New York 22, refer in a recent note to a new electronic weighing-in-motion system, designed by engineers of Fairbanks Morse and Co., now helping to speed the flow of coal from a Kentucky colliery. The equipment weighs loaded wagons as they pass over a 20-ft. rail scale, feeding the information into a totalizing printer which automatically prints out gross and net weights. Loaded wagons are first uncoupled and allowed to roll down a 2% grade on to the weighing rail. The electronic equipment accurately records each wagon's weight from its front and rear axles while it is on the move. After each wagon has been weighed it is automatically coupled to form a train for immediate dispatch.

Rapid Magnetic, Ltd., of Lombard Street, Birmingham, issue a note on their Magna Grip for lifting and handling duties, as illustrated. Independent of mains supply, unrestricted by power cables, it is of practical use in machine shops, assembly shops, warehouses, etc., attached to mobile cranes, fork-lift trucks, or

static hoist blocks. No special adaption equipment or modification to existing plant is needed. A recessed control panel houses the switch, a safety meter for recharging, and a trickle charger socket for quick connexion. Battery capacity is adequate for a full day's working.

British Ropes, Ltd., of Doncaster, recently opened their new Central Research Department, which comprises departments for wire and rope research and a marine testing station off the Norfolk coast. Investigations range from raw material through heat treatment and wire drawing to the final product and the precise physical characteristics of various types of wire are of great importance, much time being spent on the determination of, for example, fatigue strength, stress relaxation, and stress–strain factors. The rope department is divided into sections covering chemical analysis, metallurgical examinations, physical testing, fibre and synthetics' evaluation, photographic documentation, and development, each section being run by a leader who is usually a senior specialist in the science concerned. Equipment of the rope research department is extensive and varied and includes a Zeiss photo-micrographic unit, a 100-ton capacity Amsler Universal pulsatory fatigue testing machine, a Watson stereoscope microscope with camera attachments, and a Denison 15-ton capacity hydraulically operated tensile machine. The attitude of British Ropes, Ltd., to research has been summed up by the chairman, who says : " In this present age of incredibly rapid scientific development we do, and must continue to, devote an increasing amount of effort to investigating and utilizing new materials, improving the quality and versatility of our products and developing new uses for them."

Effluent and Water Treatment Exhibition and Convention

Among exhibits seen at the Exhibition, which was referred to in the November issue, mention may be made of one or two further items of interest to mining men.

British Wedge Wire Co., Ltd., demonstrated the wedge wire filter for dewatering sludges. Designed primarily for sewage work it may be developed for other applications.

Dorr-Oliver Co., Ltd., called attention to a variety of equipment and processes for water and industrial waste treatment.

Electronic Instruments, Ltd., as well as pH meters and electrode systems, including a pH alarm system, were featuring means for dealing with toxic effluents such as cyanides and chromates.

Head Wrightson Processes, Ltd., of 20–24, Old Street, London, E.C. 1, drew attention to the arrangement between the " Alfloc " water treatment service of **Imperial Chemical Industries, Ltd.,** and their company for a complete service of effluent treatment.

Industrial Pumps, Ltd., were featuring Flygt pumps, including the "GP" sump pump recently introduced to this country and the flameproof "Bibo 3," an electric centrifugal fully-submersible unit.

International Combustion Products, Ltd., were able to point out on their stand various applications for Vacseal pumps, Rovac filters, the Dynocone centrifuge, and Hardinge thickeners.

Mono Pumps, Ltd., displayed a range of their pumps for both fluid and powder applications for the handling of sludges and slurries for disposal or for filter-press pumping. In addition they showed a selection of ebonite-lined pumps and "H" types in stainless steel or gunmetal for radioactive effluents.

Permutit Co., Ltd., indicated various applications of ion-exchange plant and materials for water demineralization, softening, etc., as well as electrodialysis equipment for rendering brackish water potable.

Pneumatic Breakwaters, Ltd., demonstrated the "Bubble Gun" to create convection in liquids by means of large bubbles of compressed air, one application of which is to prevent ice formation in harbours and waterways in Arctic latitudes.

Scott Balfour Group from their Scott-Wemco division demonstrated the operation of their torque flow pumps for handling slurries.

Vokes, Ltd., brought to the notice of visitors their manufacturing arrangements with the Chain Belt Co., of Milwaukee, for the range of Rex process plant covering mechanically-cleaning bar screens, sludge collectors, "Float-Treat" separators, flocculation apparatus, and clarifiers.

RECENT PATENTS PUBLISHED

☛ A copy of the specification of the patents mentioned in this column can be obtained by sending 3s. 6d. to the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. 2, with a note of the number and year of the patent.

2,678 of 1958 (883,721). ARMOUR RESEARCH FOUNDATION OF ILLINOIS INSTITUTE OF TECHNOLOGY. Titanium production.

10,434 of 1958 (883,060). METALLGESELLSCHAFT, A.G. Hoisting and lowering gears for the chain of pallet frames of a sinter machine.

11,112 of 1958 (884,383). CANADA, MINISTER OF MINES AND TECHNICAL SURVEYS. Process for smelting ore with a cyclone combustor.

231 of 1959 (883,113). ANGLO AMERICAN CORPORATION OF SOUTH AFRICA, LTD., and R. BLAIR. Lifting, lowering, and hauling.

13,063 of 1960 (884,067). PERMUTIT CO., LTD. Removal of dissolved solids from liquids.

13,985 of 1960 (883,160). UNITED STATES ATOMIC ENERGY COMMISSION. High temperature reduction of uranium hexafluoride to metal.

29,021 of 1960 (884,506). AMERICAN ZINC, LEAD, AND SMELTING CO. Self-loading transport vehicles.

31,031 of 1960 (883,412). NORDBERG MANUFACTURING CO. Gyratory crushers.

NEW BOOKS, PAMPHLETS, ETC.

☛ Publications referred to under this heading can be obtained through the Technical Bookshop of *The Mining Magazine*, 482, Salisbury House, London, E.C. 2.

Metallurgy in the Service of Man. By W. H. DENNIS. Cloth, octavo, 372 pages, illustrated. Price 45s. London: Macdonald and Co. (Publishers), Ltd.

A Brief History of Welding Technology. By K. WINTERTON. Canadian Mines Branch, Information Circular I.C. 4. Paper covers, 81 pages, typescript, illustrated. Price 25 cents. Ottawa: Department of Mines and Technical Surveys.

The Chinese Coal Industry: Part 2, Underground Working Methods; Part 3, Stowing and Support; Part 4, Mechanization. Each part in paper covers, typescript and illustrated. Warrington, Lancs.: Joseph Crosfield and Sons, Ltd.

The Canadian Mineral Industry, 1958. Canadian Mineral Resources Division, Mineral Report 4. Paper covers, 508 pages, illustrated. Price $2.00. Ottawa: Department of Mines and Technical Surveys.

Coal Mines in Canada, Jan., 1961. Canadian Mineral Resources Division Operators List 4. Paper covers, 48 pages. Price 25 cents. Ottawa: Department of Mines and Technical Surveys.

Selection of Bore-Hole Sites for Water in the South-Western Transvaal. S. Afr. Geological Survey Bulletin 34. By S. B. DE VILLIERS. Paper covers, 68 pages, illustrated with 11 folders. Price R1.35. Pretoria: Department of Mines.

Uganda Protectorate: Mines Department Report, 1960. Paper covers, 22 pages. Price Shs. 1/20. Kampala: Mines Department.

An Introduction to Low Alloy Constructional Steels: Intended Primarily for Students. Paper covers, 12 pages, illustrated. London: The International Nickel Co. (Mond), Ltd.

Transvaal and Orange Free State Chamber of Mines: 71st Annual Report, 1960. Cloth, large octavo. 114 pages. Johannesburg: Chamber of Mines.

Safety and Health in Industry. Paper covers, 152 pages, illustrated. London: The Industrial Health and Safety Centre.

Selected Index to Current Literature

This section of the Mining Digest is intended to provide a systematic classification of a wide range of articles appearing in the contemporary technical Press, grouped under heads likely to appeal to the specialist.

* Article in the present issue of the MAGAZINE. † Article digested in the MAGAZINE.

Economics

Copper, World : *Position, Survey.* Copper Mining—What to Expect in the Year 2000 A.D. A. B. PARSONS, *Min. World* (San Francisco), Nov., 1961.

Industry, Aluminium : *Position, Australia.* Survey of Aluminium Industry. R. WARDROP, *Min. Chem. Engg. Rev.*, Oct. 16, 1961.

Lead-Zinc, United States. *Productivity, Review.* Productivity in the Lead-Zinc Industry. H. M. CALLAWAY, *Min. Engg.*, Nov., 1961.

Mining, Canada : *Industry, Northern.* The Mining Industry in Northern Canada. V. C. WANSBROUGH, *Northern Miner*, Oct., 1961.

Production, Canada : *Columbium, Quebec.* St. Lawrence Columbium Project Starts Production in Quebec. *Engg. Min. J.*, Oct., 1961.

***Production, Canada :** *Iron Ore, Quebec.* Iron Ore from Labrador. THE MINING MAGAZINE, Dec., 1961.

†Production, Hong Kong : *Minerals, Review.* Hong Kong's Mineral Depostits. *Hong Kong Trade Bull.*, July, 1961.

Resources, Australia : *Iron Ore, South.* Iron Ore in South Australia. *Min. Chem. Engg. Rev.*, Oct. 16, 1961.

Resources, Canada : *Potash, Saskatchewan.* Potash in Saskatchewan. K. A. MORTON, *Northern Miner*, Oct., 1961.

Silver, World : *Position, Survey.* What is Happening to Silver? A. KNOERR, M. EIGO, *Engg. Min. J.*, Nov., 1961.

Geology

***Economic, United Kingdom :** *Tin, Cornwall.* Structural Control of Mineralization in South-West England. R. H. T. GARNETT, THE MINING MAGAZINE, Dec., 1961.

Economic, United States : *Mercury, Nevada.* Cinnabar at Cordero. E. L. FISK, *Min. Engg.*, Nov., 1961.

Economic, United States : *Uranium, Arizona.* The Uranium-Vanadium Ore Deposit at the Monument No. 1—Mitten No. 2 Mine. I. J. WITKIND, *U.S. Geol. Surv. Bull.* 1107-C.

Economic, Uranium : *Shales, Black.* Geology and Geochemistry of Uranium in Marine Black Shales: A Review. V. E. SWANSON, *U.S. Geol. Surv. Prof. Paper* 356-C.

Exploration, Drilling : *Survey, Canada.* Some Aspects of Diamond Drilling in the Blind River Camp. D. S. ROBERTSON, *Canad. Min. J.*, Nov., 1961.

Regional, Fiji : *Report, Viti Levu.* Geology of the Nandi Area, Western Viti Levu. R. W. BARTHOLOMEW, *Fiji Geol. Surv. Bull.* 7.

Survey, Geophysics : *Magnetic, Canada.* Helicopter E.M. Test, Mobrun Orebody, Noranda. N. R. PATERSON, *Canad. Min, J.*, Nov., 1961.

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